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THESIS

TOWARD A NATIONAL SPACE
WARFIGHTING ARCHITECTURE: FORGING A FRAMEWORK
FOR DEBATE ABOUT SPACE-BASED
OPERATIONAL AND TACTICAL COMBAT SUPPORT

by

Robert O. Work

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The primary objective of this thesis is to propose a template for a National Space Warfighting Architecture (NSWA). The template is intended to fill the void that exists between national security space policies and the services' space warfighting plans. As such, it will provide a unifying framework for follow-on discussions and debate about the proper direction of space-based operational and tactical combat support. In support of this objective, this thesis aims to: provide the proper focus for the architecture; identify the key conceptual ideas that should drive its development; establish a common vocabulary among managers of the Space-based Strategic Reconnaissance/Surveillance Program, service space support officers, and terrestrial warfighters; develop a logical and meaningful architectural organizational approach; facilitate the comparison between

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Toward a National Space Warfighting Architecture: Forging a Framework for Debate About Space-based Operational and Tactical Combat Support

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ABSTRACT

The primary objective of this thesis is to propose a template for a National Space Warfighting Architecture (NSWA). The template is intended to fill the void that exists between national security space policies and the services' space warfighting plans. As such, it will provide a unifying framework for follow-on discussions and debate about the proper direction of space-based operational and tactical combat support. In support of this objective, this thesis aims to: provide the proper focus for the architecture; identify the key conceptual ideas that should drive its development; establish a common vocabulary among managers of the Space-based Strategic Reconnaissance/Surveillance Program, service space support officers, and terrestrial warfighters; develop a logical and meaningful architectural organizational approach; facilitate the comparison between space-based and terrestrial-based combat support systems; and show how the NSWA fits within the larger framework of the National Space Program.

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I. INTRODUCTION

A. SPACE-BASED OPERATIONAL AND TACTICAL COMBAT SUPPORT: A NOVEL IDEA

The rapid and impressive growth of our (and others') civil space programs makes it easy to forget that man's use of space is a relatively new occurrence. Robotic surveys around and beyond our solar system, manned trips to the moon, and myriad activities in near-earth orbit belie the fact that the space age is not quite 33 years old. If the history of mankind is thought of as a single 24-hour day, all of men's space ventures have taken place during the last 0.8 second [Ref. 1:p. 44].

Likewise, the explosive growth of military space programs obscures the fact that the use of space to provide routine combat support to operational and tactical forces is a new, even novel, military development. To be sure, these forces have relied on space systems to provide them with some communications, weather, and navigational support almost from the dawn of the space age. However, national security space systems were conceived and evolved essentially to serve the National Command Authorities (NCA), the National Intelligence Community (NIC), and the strategic nuclear deterrent forces [Ref. 2:p. 22]. It was not until 1988 that the national security space sector was explicitly tasked to "meet the

requirements of operational land, sea, and air forces through all levels of conflict commensurate with their intended use" [Ref. 3:p. 8].

As a result of this high level direction, space-based support to terrestrial fighting forces is now a major mission of the national security space program. In the words of Rear Admiral David Frost, USN, former commander of the U.S. Naval Space Command:

> A lot of what's being discussed in space right now is applying space assets more directly to the operational problem of theater...and lower commanders...It really represents a major shift in this country's approach to the military space program...The whole Navy is in favor of more movement in this direction. [Ref. 2:p. 22]

With the recent changes in the international climate and the relaxation of tensions with the Soviet Union, U.S. combat forces should expect the momentum behind more responsive space-based warfighting support to increase. Two primary factors are driving this growing momentum. First, U.S. military forces will be smaller, and a greater proportion of these forces will be based within the continental United States. And second, diverse and largely unpredictable military threats from nations other than the Soviet Union will preoccupy U.S. military leaders. Thus, the Department of Defense (DoD) will become increasingly dependent on space systems to provide timely crisis tip-offs and to support the movement and control of U.S. combat forces around the globe. And combat commanders will be able to increasingly rely on

national space-based support to increase the effectiveness of their smaller forces [Ref. 4:p. 10]. To quote General John L. Piotrowski, USAF, former Commander-in-Chief (CINC) of the U.S. Space Command:

> Tomorrow's space operations will be pervasive in combat. While today's operations provide our commanders extensive support, tomorrow's will provide even more. Commanders will depend on space as they now depend on strategic and tactical airlift...field artillery support and the like. They have every right to expect this. Space operations tomorrow will be characterized by...support to our tactical forces that is more timely, more simple, more direct, and readily available when they need it most. [Ref. 5:p. 65]

B. THE KEY PREREQUISITE: OVERCOMING THE "TENCAP ATTITUDE"

Before General Piotrowski's vision of routine, pervasive, and responsive space-based warfighting support can be realized, the information available from national security space systems must be **integrated** within existing military forces so as to become an indispensable contributor to terrestrial operations [Ref. 6:p. 5]. This will be easier said than done. There is a healthy amount of skepticism about the practicality of national space-based operational and tactical support within the fighting forces. This deep-seated skepticism is due largely to the military's experience with **exploitation** of information derived from the U.S. Space-based Strategic Reconnaissance/Surveillance Program (SSRSP).

As its name implies, the SSRSP was developed to provide indications and warning of aerospace attack on the U.S., strategic intelligence and warfighting support, and to prevent

technological surprise. In fact, the SSRSP arguably provided the primary motivation for the U.S. move into space, and its first on-orbit components data back to 1960 [Ref. 7:pp. 66, 100, and 106]. Such was its success that its operations became and remain one of the most closely held secrets of the government. It was not until 1973, when the Army opened its TENCAP (Tactical Exploitation of National Capabilities) Office, that the veil of secrecy surrounding the SSRSP was lifted enough to explore the possibility of tasking the SSRSP to support the needs of operational and tactical commanders [Ref. 8:p. 1-3].

Despite this early Army initiative, the services clearly were reluctant to count on, or plan for, routine space-based reconnaissance support during wartime. It literally took an act of Congress -- buried in a 1977 Joint Appropriation Report -- to spur the Navy, Air Force, and Marine Corps to establish their own TENCAP offices [Ref. 8:p. 1-3]. One immediate result of the proliferation of TENCAP programs was the Joint Tactical Exploitation of National Systems (JTENS) manual -- a superb effort which outlines the steps necessary for warfighters to task the SSRSP for reconnaissance support. But images taken from space were so highly classified and subject to so many handling and dissemination restrictions that the integration of space-based reconnaissance information into fast-moving combat operations was impossible. The long-time strategic focus of the SSRSP and the strict secrecy

surrounding its operations conspired against any real change in the attitudes about space-based combat reconnaissance -- by either the SSRSP managers or the warfighters.

These deeply entrenched attitudes finally began to change in the mid-1980's. The establishment of the U.S. Space Command in 1985 provided a forum to forge a joint position on space-based reconnaissance support. One of the first tasks that the Command tackled was a revision of the Department of Defense Space Policy. At the insistence of the Marine Corps and the Army, the 1986 draft of the DoD Policy included a call upon the national security space sector to provide "operational" support for terrestrial forces [Ref. 9:p. 24]. This position found high-level support, and it was subsequently incorporated into the next National Space Policy (NSP), signed by President Reagan on 5 January 1988 [Ref. 3:p. 8].

This new policy notwithstanding, many warfighters continue to doubt that the SSRSP and its managers have either the capability or the inclination to meet their tactical reconnaissance needs. The most telling evidence in support of the former assertion is found in the U.S. Space Command's intention to pursue a family of Tactical Satellites (TacSats), expressly designed to provide direct support to military commanders. While TacSats will also provide communications and weather support, the comments of a former CINC of the

Space Command make clear that reconnaissance is a key driver in the program:

> In my opinion, the combat commanders need assured support from space systems to answers critical battlefield questions like: "Has the enemy wing dispersed? Is the bridge intact? Are there any naval combatants in the operations area? Where is the division command post?" The answer to these questions are critical to the outcome of battlefield engagements. They drive the targeting of long-range weapons and influence the tactics a commander chooses. [Ref. 10:p. 45]

By supporting TacSat development, it is clear from these comments that the joint commander tasked with coordinating space-b sed combat support does not believe that the SSRSP has the capability to reliably answer these questions.

In defense of the second assertion, consider the following passage. It is taken from a 1990 article by a Marine Intelligence officer entitled "Our Continuing Self-Delusion Regarding Tactical Intelligence Capabilities:"

> **Fallacy #1: National Systems Are There to Support the Tactical Commander.** The primary responsibility for the national systems in operation today is to collect indications and warnings and technical intelligence at the strategic level...Keep in mind that if we do get committed to a Third World conflict, the alerting responsibility for which our national systems were created will not go away (in fact, it would probably increase if the Soviets are backing the other side). Indications and warnings will still remain their priority. The standard response to this argument is "what about JTENS?" Isn't that set up to ensure that the tactical user gets support? JTENS is an afterthought. The system was developed to support strategic goals. If critically short national assets can also be used to support tactical ground operations that's fine, but not at the expense of ignoring our strategic requirements. [Ref. 11:p. 56]

It would be easy to dismiss the foregoing doubts as unjustified in light of the recent tasking of the national security space program to provide "operational" support to sea, air, and land forces. It would also be easy to believe that these doubts are restricted to operations of the super-secret SSRSP, an do not apply to the general concept of space-based combat support. To do either, however, would be unwise. The 1989 Naval Space Master Plan bluntly states that the Navy and Marine Corps "will receive only limited tactical support from the current inventory of overhead assets" [Ref. 12:p. ES-2]. A recent article warns the Army that there is no dedicated satellite support for tactical commanders within a theater of operations, and that they will "have little or no chance to use satellites already in orbit during times of war" [Ref. 1:p. 44].

With such widespread attitudes and doubts about the availability of space-based combat support, it is perhaps easier to understand why U.S. ground forces were not ready to use the available services of the Global Positioning System (GPS) in potential combat operations against Iraq in August 1990. The GPS system, in development since 1973, will ultimately consist of a constellation of 21 transmitting satellites that will provide highly accurate position, velocity, and time measurements to any warfighter with the proper receiver. Its tactical utility in a desert environment that poses severe navigational challenges is easy to envision.

Unlike the operations of the SSRSP, the GPS has been a "white" program from its inception, designed specifically with the warfighter in mind. GPS development satellites have been on-orbit for over a decade, providing ample time for each of the armed services to plan for the complete integration of the GPS into their operations and tactics [Ref. 13:p. 1-7]. The Air Force declared the system operational on 9 May 1990 (Ref. 14:p. 18], and as of 24 August, there were 14 on-orbit GPS satellites capable of providing users with latitudes and longitudes for up to 20 hours a day, and altitudes for up to 15 hours a day [Ref. 15:p. 2].

Given these seemingly perfect circumstances, it would be logical to expect that the services would be well-equipped to use GPS in their operations and tactics. But such is not the case. Both the Army and the Marine Corps were forced to make emergency purchases of commercial GPS receivers to equip units deploying to the Gulf [Ref. 16:p. 3]. And in the words of Assistant Commandant of the Marine Corps, the units given receivers "are still learning how to use them" [Ref. 17:p. 74].

Why were our forces caught unprepared? The reason is simple: warfighters doubted that the navigational service would be available to them in time of war. According to the commander of the Army Space Command, "(Army units) are no longer asking 'Are those (GPS) satellites going to be there during war? Can we really trust the Air Force to fly them?'"

Instead, the commander reports, there is now "fierce" competition among combat units for limited GPS receivers [Ref. 18:p. 2]. This graphic example of warfighters' "wait and see" attitude about space-based combat support clearly demonstrates that their skepticism goes far beyond misgivings about the SSRSP.

The foregoing examples are by no means exhaustive. But in the author's opinion, they reflect a widespread attitude that must be changed before General Piotrowski's dream of pervasive space-based combat support will become a reality. The national security space sector must sweep away the very real doubts created by an outdated, nearly two decade-old approach toward space-based combat support -- the Tactical Exploitation of National Capabilities.

The conceptual foundation for TENCAP is that national space systems are first and foremost a strategic deterrent, intelligence, and warfighting asset. As a result, operational and tactical commanders have no guarantee that the systems will support them in times of war, and little incentive to integrate their capabilities into wartime plans. Moreover, TENCAP information is often characterized by severe handling and dissemination restrictions, limiting its use almost exclusively to intelligence channels. These restrictions hinder the development of other national system applications with exciting tactical potential. Finally, TENCAP is a

technologically driven approach to space-based combat support; on-orbit capabilities drive tactics and not vice versa.

The symptoms of the associated TENCAP attitude are evident in the examples outlined above. The first is widespread skepticism within the warfighting forces about the availability, usefulness, cost effectiveness, or combat effectiveness of space-based combat support. The second is a widespread call for dedicated combat support satellites. The third is the absence of new tactics **based on** unique space capabilities. Indeed, there is a failure of combat forces even to be prepared to exploit space capabilities in their combat operations. The final symptom, alluded to but not previously discussed, is an intensive education effort by the space community to cure the TENCAP attitude. This effort is made difficult by the very information restrictions that characterize the TENCAP approach. Quoting Admiral Frost again:

> A lot of (space programs) tend to be classified, and classified to the point where a lot of the average fleet operators are not cleared to know some of the things they would like to know about it. [Ref. 2:p. 22]

How can the "TENCAP attitude" be overcome? One alternative might be to embrace a new approach toward space-based combat support: the Tactical **Integration** of National Capabilities (TINCAP). The conceptual foundation for TINCAP is that war -- any war -- is such a dangerous policy decision that all available means and advantages must be fully

exploited to achieve quick victory. The **entire** national security space program is viewed in essence as a combat support organization, ultimately designed to create warfighting advantages across the spectrum of conflict. This is not to imply that the national security space program will not have a "main effort." But it does imply that the main effort can be flexibly tailored to meet wartime contingencies. This approach to space-based combat support is focused squarely on the warfighter and not on technology. As a result, it seeks to foster the development of new tactics and techniques based around the unique advantages of space systems, to truly integrate space-based combat support into terrestrial operations.

C. A FRAMEWORK FOR DEBATE: A NATIONAL SPACE WARFIGHTING ARCHITECTURE

Is the skepticism warfighters feel about receiving combat reconnaissance support from the SSRSP justified? In an era of declining defense budgets, is the decision to pursue dedicated space-based combat support platforms a wise one? Is there any real difference between TENCAP and TINCAP? These are questions that go to the heart of the debate about space-based combat support. Their answers will in large part determine if warfighters will ever come to depend on "space as they now depend on strategic and tactical airlift,...field artillery support and the like."

Unfortunately, when debate and argument take place outside a mutually accepted framework for discussion, the result often resembles two simultaneous monologues, with no real attempt by the disagreeing parties to reach an amicable solution. But when debate and argument take place within a mutually accepted framework, the result is often meaningful dialogue -- an open and frank exchange of ideas that leads to common understanding and harmony [Ref. 19:p. 503].

One way to establish such a framework is to develop simple questions that guide and shape the debate. For example, the Navy has three prioritized questions that must all be answered before developing a space system:

- Is the requirement critical enough to justify the investment?
- Is a space system or program the only reasonable way to achieve the required capability?
- Is the capability achievable/affordable? [Ref. 12:p. 5-1]

However, such questions still do not provide any common ground between space support officers and warfighters. For example, the requirement for accurate and timely tactical reconnaissance for military operations is considered self-evident. So the next key test is whether or not a separate space-based reconnaissance system is the only reasonable way to achieve the support not already provided by, or what can be reasonably expected from, the SSRSP and terrestrial reconnaissance systems. The only way to effectively debate

this question is to have framework -- an architecture -- that establishes a common conceptualization of space-based combat support among the managers of the SSRSP, service space support officers, and the warfighters.

Therein lies the rub. While each service is busily pursuing its own version of a space warfighting architecture, the guide for their development and the glue to integrate them within the entire national security space program -- a National Space Warfighting Architecture (NSWA) -- is absent. Moreover, the evolving service architectures seem to focus more on space systems and space decision makers and less on the warfighter and how space can help him win a fight. For example, consider Figure 1, an early version of a "generic" Naval Space Warfighting Architecture [Ref. 20:p. 1-3]. Notice its emphasis is on on-orbit satellites and satellite control networks. It is hard for the author to conceive how this emphasis would help a warfighter to understand the conceptual underpinning of space-based combat support; or to understand how he might best integrate space-based support into his combat plans and operations. The focus on technology and physical and informational structures is arguably of great assistance to space support officers. The problem is that this is the wrong focus and wrong audience for a **warfighting** architecture. The only proper focus and audience for a warfighting architecture is war and the commanders and forces tasked to win it.

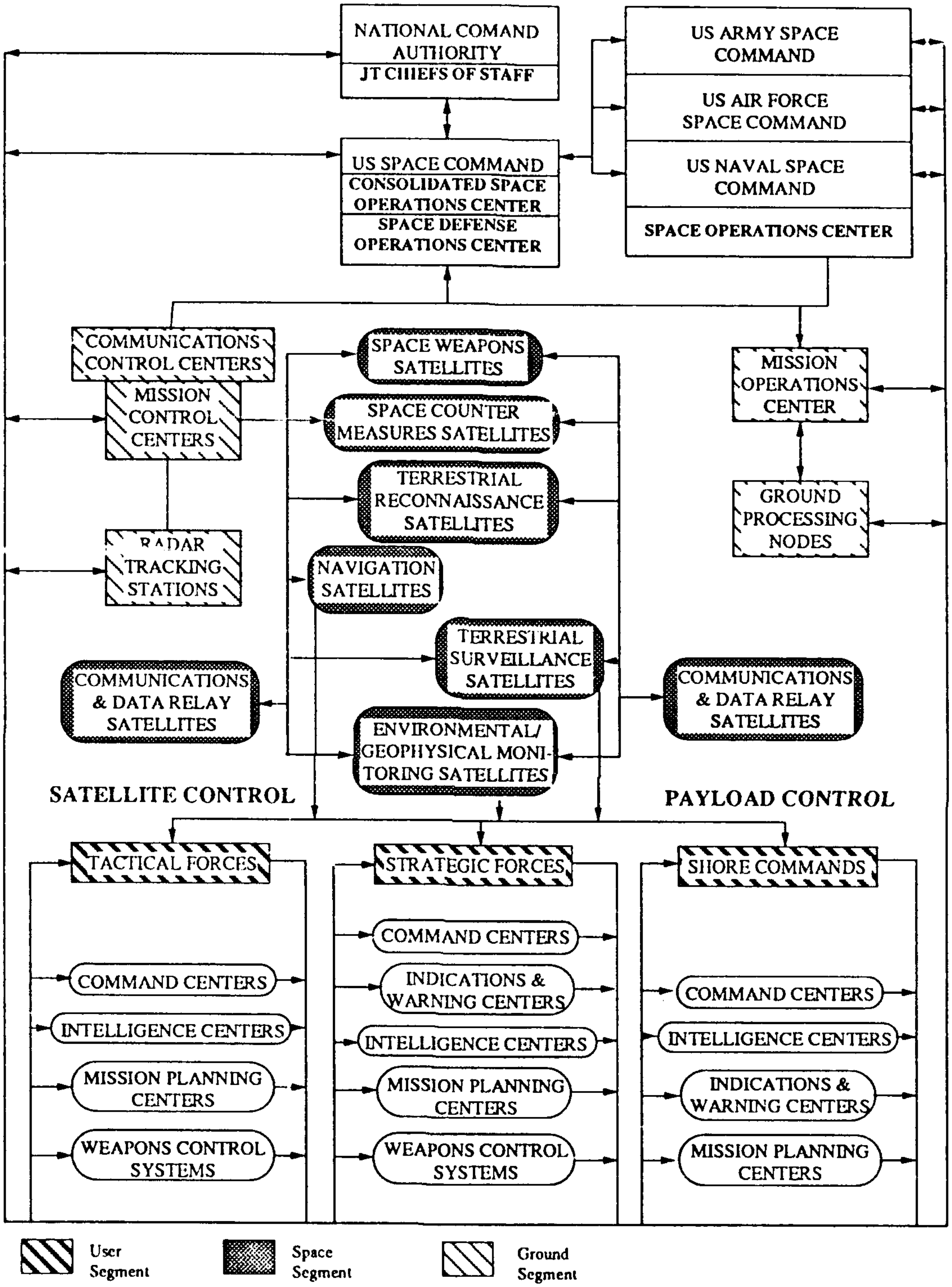

Figure 1. "Generic" Naval Space Warfighting Architecture

A central premise of this thesis is that until a true National Space Warfighting Architecture is developed, there will be neither meaningful integration of national space capabilities into our operating forces, nor meaningful debate about which operational and tactical combat support roles are best conducted from space.

D. OBJECTIVE

The primary objective of this thesis is to propose a template for the development of a National Space Warfighting Architecture. The template is intended to fill the void that exists between national security space policies and the services' space warfighting plans. In support of this objective, this thesis aims to: provide the proper focus for the architecture; identify the key conceptual ideas that should drive its development; establish a common vocabulary among managers of the SSRSP, service space support officers, and the warfighters; develop a logical and meaningful architectural organizational approach; facilitate the comparison between space-based and terrestrial-based combat support systems; and show how the NSWA fits within the larger framework of the National Space Program. The ultimate goal of the NSWA is to provide a starting point for follow-on discussions and debate about the proper direction of space-based operational and tactical combat support. As such, the author hopes to highlight a new way of looking at how space-

based combat support can aid in the preparation and execution of battle.

E. SCOPE, LIMITATIONS, AND ASSUMPTIONS

The template for the National Space Warfighting Architecture is not intended to be complete; it is a top-level architecture only. As such, the **scope** of this thesis covers the broader conceptual and organizational aspects of space-based operational/tactical combat support. Technological concepts will be discussed only as they relate to this top-level architecture.

In the author's opinion, one of the primary reasons why the idea of space-based combat support has yet to be fully embraced by warfighters is because of the secrecy surrounding many of the operations of the national security space sector. Until the veil which covers national space systems is at least partially lifted, education efforts aimed at increasing the awareness and appreciation of national capabilities will be severely hindered. The author therefore felt compelled to write this thesis at the unclassified level. While this decision will ensure the widest possible forum for any follow-on discussion or debate, it also ensures that many fundamental issues concerning space-based combat support cannot be covered due to security reasons. This is the key **limitation** of this thesis. An important theme that runs throughout this work is that it is time to reevaluate the impact that classification

policies have on attempts to integrate space information into combat operations and tactics.

This thesis is written by a Marine (primarily) for other Marines. The author hopes that it will stir interest about space-based support to Marine Air Ground Task Force (MAGTF) operations and to spur the Marine Corps leadership to lead the way in driving the integration of national systems into combat training and operations. However, another of its aims is to introduce the managers of national security space programs to important warfighting concepts. Therefore, the author's only **assumption** is that most of the national security space managers do not understand war, and most Marines do not understand space-based combat support. Hopefully, this thesis will help to establish a common dialogue between the warfighters and the managers tasked to support them.

II. TOWARD A NATIONAL SPACE WARFIGHTING ARCHITECTURE

A. INTRODUCTION

A very real problem facing space support officers is the difficulty in measuring or demonstrating the operational and tactical utility of space-based combat support. For example:

> The challenge of a strong naval role in space continues to be the quantification of the value added to naval warfare in...operating relatively high cost space systems. This can be overcome by (providing) a greater realization of the potential support (offered) by space-based assets. [Ref. 12:p. ES-8]

One way around this problem is to create a conceptual framework that demonstrates how to view space-based combat support within the overall context of war and warfighting. This framework would purposely reverse the normal thrust of articles on military space operations. Instead of trying to turn warfighters into space warfare experts, it would attempt to make space support officers more aware of the nature of war. In place of orbitology primers and listings of on-orbit satellites and their capabilities, this framework would present, **from the point of view of a warfighter**, how national space capabilities can best be used to influence the outcome of war on earth. Such a framework would take the form of a National Space Warfighting Architecture.

B. JUST WHAT IS A (WARFIGHTING) ARCHITECTURE?

In its broadest sense, architectural design involves the engineering of systems of systems [Ref. 21:p. 1]. A system is a set of interacting people, resources, and procedures that receives input from its operating environment, transforms these inputs in some way, and then transmits outputs back into the environment. This definition implies that the system is an "open" one. That is, the system adapts to the environment as well as adapts the environment to itself [Ref. 22:p. 4].

The hierarchy of architectural design is composed of three critical, interdependent tiers [Ref. 21:p. 1]. The top level of the hierarchy is the architecture itself -- a set of purposive, organized, and interrelated decision makers (some human, others automated), with an associated information flow, performing assigned missions within a common environment [Ref. 22:p. 3]. Its ultimate goal is to create unity of effort and cohesiveness among decision makers in the accomplishment of their missions [Ref. 23:p. 1]. A critical point that bears reemphasis is that an architecture springs from and is guided by its explicit design missions. If the architecture is to support more than one mission simultaneously, unity of effort demands that these missions be prioritized in an unambiguous way. This prioritization need not be static; more often than not the priority of the architecture's design missions change dynamically with changes to the architecture's environment [Ref. 24].

When a top level architecture is decomposed into is component physical human systems, the result is called system engineering. System engineering transforms an operational need identified by the top level architecture into specific measures of component system performance. It also develops component system configurations designed to integrate chosen technologies into the top level architecture and ensure the compatibility of all systems' physical, mechanical, and functional interfaces. The goal of system engineering is to clarify and optimize each component system's definition and design within the overarching framework of the top level architecture [Ref. 22:p. 2].

The lowest, most detailed rung on the architectural design ladder is design engineering of each component system's subsystems [Ref. 21:p. 1]. Both system and design engineering are useful, even vital, when attempting to explain how specific technologies are to be used to support the top level architecture's decision-making structure. But if it is accepted that the architecture's design missions ultimately drive the selected technologies and not vice versa, **then it is neither necessary nor prudent to include this level of detail in the "top level" architecture.**

Remember that an architecture's main goal is to foster unity of effort and cohesiveness among decision makers in the accomplishment of assigned mission(s). Once its design missions are selected, the role of the top level architecture

is to provide a common understanding or conceptualization of: the environment in which the decision makers operate; individual and organizational decision making concepts, and architectural organizing approaches [Ref. 23:p. 1]. On the other hand, the system engineering level aims to describe how a selected group of technologies can be forged together to facilitate some specific aspect of the top level architecture's decision-making process. Since these descriptions exhibit many architectural characteristics, including decomposition to a lower, more detailed level (design engineering), system engineering will hereafter be referred to as the subarchitecture tier of the architectural hierarchy.

The transition between a top level architecture and its associated subarchitectures is marked by a sublevel that lists all decision-making tasks that may be accomplished or aided through the intervention of technology. This transition sublevel works in two ways: it identifies to the architecture's decision makers all those tasks that are technologically feasible; and the presence of a subarchitecture indicates that a specific technology to accomplish a task has been pursued and integrated within the architecture's decision-making structure. In this way, the top level architecture is able to spell out how selected, available technologies can be used to assist its decision

makers without resorting to the level of technical detail found in its component subarchitectures [Ref. 23:p. 1].

With the foregoing architectural concepts as a guide, it is time to return to the question posed in the title of this section: Just what is a warfighting architecture? A warfighting architecture is a top level view of the information processing, decision making, an action processes of combat organizations [Ref. 23:p. 1]. This definition is important in that it equates designing architectures to designing an organization with a common mission. Organizations are composed of (groups of) people as well as machines. But the organization's basic building blocks are people and their roles in the organization. Therefore, a top level warfighting architecture properly focuses on warfighting commanders and their forces and not on the technology that serves them [Ref. 22:p. 3].

Organizations exist to accomplish some mission. A warfighting architecture's combat missions convey how it is expected to alter the wartime environment in such a way as to influence the opponent, or perhaps more correctly, the opponent's behavior. In turn, the architecture identifies, either explicitly or implicitly, its overall "environmental influencing strategy." Combat organizations operate in a hostile, ever-changing environment where adherence to preset plans is tantamount to disaster. If a combat architecture hopes to accomplish its assigned missions, it must be capable

of real time adaptation to the wartime environment. One of the most important requirements of any architecture's design is that it must match its operating environment. Only in this way will the architecture's environmental influencing strategy be effective and its missions be accomplished [Ref. 23:pp. 1-2]. This is especially true of a warfighting architecture.

In addition to highlighting its influencing strategy, a warfighting architecture is deliberately structured to identify all relevant combat decision-making processes and functions. However, since the architecture seeks to foster unity of effort among many divergent combat units working toward a common mission, its processes and functions must have a conceptual rather than a specific flavor. Although they must be specific enough to provide common understanding and cohesiveness among the architecture's decision makers, they must also be broad and flexible enough to apply to all combat roles performed by different types of decision makers. [Ref. 24]

Boundaries explain what is part of an organization and what is not. A warfighting architecture's boundary surrounds only those forces involved in combat. In this way, the fighting forces' unique operating environment, missions, influencing strategies, functions, and technologies are brought sharply into focus [Ref. 22:p. 4]. To be sure, the warfighting architecture may be supported by different sets of decision makers, operating in different environments.

However, these supporting architectures and subarchitectures have a common characteristic: their decision makers never face the same moral or physical demands of combat. A warfighting architecture deals with war and those who fight it; those not buffeted by war's hostile environment are excluded from its boundary.

One final point. A warfighting architecture deals with technology only insofar as it identifies those technological concepts that can be used or pursued to assist warfighting forces to accomplish their combat missions. Specific technologies, system components, or physical structures have no place within a top level view of combat decision and action. These technical details are properly reserved for the warfighting architecture's supporting subarchitectures.

C. WHY A NATIONAL SPACE WARFIGHTING ARCHITECTURE?

Having discussed the characteristics of architectures in general and warfighting architectures in particular, it is now time to focus in on the main subject of this thesis: a National Space Warfighting Architecture. A NSWA will fill the void that presently exists between national and DoD military space policies, and the services' efforts to define their own roles in space. As a top level architecture, its primary intent is to foster unity of effort and cohesiveness among the services and the **entire** national security space sector with regards to space-based combat support. And as a warfighting

architecture, it focuses more on how commanders and their forces can best use space-based support to gain an advantage in earthly combat, and less on the capabilities or combat utility of specific space assets.

The conceptual intent of the NSWA is akin to that of an "operational" space doctrine. An operational doctrine is:

> derived from "basic" doctrine, and in turn, should apply (its) basic principles within "the context of distinct objectives, force capabilities, broad mission areas, and operational environments." [Ref. 25:p. 59]

Some might therefore argue that the development of the NSWA should be delayed in favor of forging a joint service operational space doctrine. The author rejects this argument for three reasons.

First, there is no basic military space doctrine to guide or shape the development of an operational space doctrine. Basic doctrine "includes the most fundamental and enduring beliefs that guide the proper use of (fighting) forces in military action" [Ref. 25:p. 59]. There is a document entitled AFM 1-6, Military Space Doctrine [Ref. 6], but it neither applies to the military as a whole nor is it doctrine in the truest sense of the word. It is an Air Force document, not even cited by the Navy in the development of their Space Master Plan [Ref. 12:p. 10]. And in the words of one Air Force officer, "instead of explaining how US space forces will be employed in future conflicts, it simply restates current public policy (about space)" [Ref. 25:p. 57]. On the other

hand, the only requirement to start development of a space warfighting architecture is a clear statement of the missions it is designed to support. As will be seen, these missions are evident at both the national and DoD level.

Second, because each of the services are pursuing their own vision of space warfare, it will be difficult in the near term to force a universally accepted or applicable space warfighting doctrine. For example, the Navy envisions space as "a place that offers the Navy certain advantages in executing already existing roles and missions [Ref. 26:p. 39]. Not surprisingly, the official Navy position on space is that "space systems acquisition, development, and operation must be for a single purpose -- to support the warfighter" [Ref. 12:p. ES-3]. Meanwhile, the Air Force emphasizes the development of a space warfighting capability. According to <u>AFM 1-6:</u>

> The nation's highest defense priority -- deterrence -- requires a warfighting capability across the spectrum of conflict. From the battlefield to the highest orbit, airpower will provide that capability. [Ref. 6:foreword]

This emphasis is especially evident in recent calls within the Air Force for a national military space doctrine of space superiority. The logic behind this argument is that the principal mission of the army is the destruction of the hostile army, and the principal missions of the navy and air force are the destruction of the hostile navy and air forces,

respectively. Ergo, "it would seem to follow that the principal missions of US military space forces should be the destruction of hostile space forces" [Ref. 25:p. 58]. With such divergent service views about the primary mission of space forces, it is hard for the author to imagine that a consensus on military space doctrine will emerge without a better conceptual framework for discussion and debate about the role of space in war. A NSWA is ideally suited to provide such a framework.

Third, in the author's opinion, a "military" space doctrine is simply not enough if the services ever hope to move beyond the hobbling view of TENCAP and to fully integrate all available space capabilities into their plans and operations. While exploitation is the act of turning to one's own use [Ref. 19:p. 646], integration is the act of putting or bringing (parts) together into a whole; a unification [Ref. 19:p. 953]. As long as the SSRSP operations are treated separately from other military space operations, the conceptual foundation of military space support will remain squarely on the former at the expense of the latter. Only a truly national conceptualization of space-based combat support can hope to unify all elements of the national security space program into a cohesive whole. The best means toward this end would seem to be National Space Warfighting Architecture. Paraphrasing the reasoning behind the Navy's decision to develop a Naval Space Warfighting Architecture, a NSWA

provides a structure that will enable all components of the national security space sector to address space-based combat support issues from a common point of departure through the employment of a standard set of terminology [Ref. 1:p. E-1].

D. THE NATIONAL SPACE WARFIGHTING ARCHITECTURE'S NINE BUILDING BLOCKS

Given that a National Space Warfighting Architecture is the best means to unify the services' emerging warfighting plans and architectures, the next step is to develop the building blocks necessary for its construction. The first such building block is a common vocabulary. As a framework for dialogue about space-based combat support among all members of the national security space sector, the NSWA's vocabulary must necessarily include important warfighting concepts and terms.

The second building block consists of the NSWA's design missions. As has been said, an architecture's development springs from and is guided by a set of explicit design missions. Without a consensus about these missions, the NSWA will be dead in its tracks.

By its very nature, a NSWA excludes from its boundaries many important space support decision makers. Therefore, the third building block is the NSWA's relationship to all other national security space architectures.

The next building block is a thorough understanding of the architecture's operating environment -- war and combat. Along

with a supporting vocabulary, a common conceptualization of the warfighting environment will be critical to establishing unity of effort in space-based combat support among the diverse members of the national security space sector.

The fifth building block consists of individual decision making concepts. These concepts are especially critical for an architecture that hopes to be equally relevant to all warfighters, and universally applicable to all combat situations. The heart of the NSWA must be a generic model that effectively explains the combat decision action cycle [Ref. 23:p. 1].

The sixth building block expands the individual decision making concepts to include organizational decision making concepts. A common understanding of individual decision making is clearly not enough in a warfighting architecture. The NSWA must also successfully portray the relationships between and among the architecture's interrelated decision makers, at all echelons of command [Ref. 23:p. 1].

The seventh building block, the architecture's organizing strategy, is inextricably linked to both individual and organizational decision making. The organizing strategy determines the physical framework of the architecture in that it forces choices about how to structure the architecture's decision makers and how to describe their decision making processes [Ref. 23:p. 3]. In other words, this building block represents the NSWA's decomposition strategy.

The next building block consists of technological concepts. Technological concepts will mark the lower-most stage of the NSWA's decomposition strategy. They define the interrelationship between space technologies and the NSWA's decision makers by matching tasks associated with the architecture combat decision action process to feasible space support capabilities [Ref. 23:p. 1].

The NSWA's final building block is its environmental adaptation strategy. Recall that architectures constrain the range of strategies that can be used by decision makers to influence their environment or enemy. As will be seen, however, the Air Force and the Navy differ significantly from the Army and the Marine Corps in how they attempt to influence their enemies. A key to forging a consensus about space-based combat support will hinge on the NSWA's ability to accommodate and facilitate the very different combat adaptation strategies of each of the services.

E. ORGANIZATION OF THE STUDY

The remainder of this thesis will by and large be concerned with developing the NSWA's nine architecture building blocks, and constructing these blocks in such a way as to present a new conceptualization of space-based combat support. The next chapter, **National Space Policy: Establishing the Basis for a NSWA,** identifies the NSWA's baseline combat missions and identifies the relationship

between the NSWA and supporting national security space architectures. Chapter IV, **War: the Desperate Gamble**, will define the NSWA's operating environment. It introduces the unique elements that shape the atmosphere of war and the climate of combat. The next chapter, entitled **"Warfighting Concepts**, serves two purposes. It expands the vocabulary of war started in Chapter IV, and introduces several concepts important to the NSWA. Chief among these concepts are the different levels of command in war, key to the NSWA's "how-to-organize" approach; and the two different combat adaptation strategies: attrition and maneuver. **The Combat Action Process: A Model**, presents a conceptual model of both individual and organizational decision/action cycles in combat. The model will be universally relevant: it applies equally to all services, at all levels of command, and in all tactical situations. This model will be the central building block of the NSWA. Chapter VII, **The National Space Warfighting Architecture**, takes the building blocks developed in the previous four chapters, and constructs the NSWA. The **Conclusions and Recommendations** chapter will highlight the key points presented throughout the thesis, and offer some recommendations to the National Security Space Sector, the US Naval Space Command, and the US Marine Corps.

III. NATIONAL SPACE POLICY: ESTABLISHING THE BASIS FOR A NSWA

A. INTRODUCTION

The decision to develop a National Space Warfighting Architecture triggers two immediate requirements. The first is to identify the architecture's appropriate combat missions. These combat missions, when viewed within the context of the architecture's special operating environment, help to precisely define the limit an shape of the NSWA's boundary.

As has been stated, this boundary excludes from its confines some important space support decision makers who operate in different environments. In other words, the NSWA is only one of several interrelated, yet distinct, national security space architectures. How many others are there? What are the relationships among them? The second requirement is to fashion the answers to these questions.

Since the use of space to support national security objectives in general, and warfighting forces in particular, is a policy decision of the highest order, it is perhaps unsurprising that the basic answers to these two questions are found within the National Space Policy (NSP). Accordingly, the first order of business is to determine how the National Space Warfighting Architecture is related to, and shaped by, the NSP.

B. NATIONAL SPACE POLICY: AN OVERVIEW

1. General

The current version of the National Space Policy dates back to 5 January 1988. The result of a five-month long interagency government review, it reflects all prior Presidential decisions concerning space, the recommendations of a National Commission on Space, and an analysis of the implications of the 1986 Space Shuttle disaster [Ref. 3:p. 1]. In its eleven short pages, the NSP spells out the government's strong commitment to a robust national space program, and leaves little doubt that national security considerations are a key driver behind this commitment. For example, the first goal of US space activities is "to strengthen the security of the United States." Moreover, of the policy's seven guiding principles, the first two read:

> -- The U.S. is committed to the exploration and use of outer space by all national for peaceful purposes. "Peaceful purposes" allow for activities in pursuit of national security goals.
>
> -- The U.S. will pursue activities in space in support of its inherent right of self-defense and its defense commitments to its allies. [Ref. 3:pp. 1-2]

After outlining its overall goals and principles, the NSP then presents its four key components: the Civil, Commercial, National Security, and Inter-Sector Space Policies, and their associated sector guidelines. Each will be discussed in turn.

2. The Component Policies

a. The Civil Space Policy

The Civil Space Policy is geared toward those space activities which enhance the Nation's "science, technology, economy, pride, sense of well being, direction,...world prestige and leadership." Centered around the efforts of the National Aerospace and Space Administration (NASA), the civil space program's primary objective is to expand knowledge of the Earth, its environment, the solar system, and the universe [Ref. 3:p. 2].

b. The Commercial Space Policy

The Commercial Space Policy encourages the development of a national commercial space sector, one that relies on market forces to create programs that hold potential economic benefit to the US. However, commercial sector programs are regulated, in part, by "national security space considerations" [Ref. 3:pp. 2-3]. This is in apparent reference to the commercial space sector guidelines, which direct the Department of Commerce to recommend options for future "advanced earth remote sensing systems for commercial use" [Ref. 3:p. 7]. Clearly, such systems have potential military applications.

c. The National Security Space Policy

The National Security Space Policy states that space activities will help the US achieve its overall security objectives by: deterring, or defense against an enemy attack;

assuring continued access to space; negating enemy access to or use of space; and enhancing the operations of US forces and her allies [Ref. 3:p. 3]. To accomplish these objectives, the NSSP goes on to codify the four broad space mission areas designated by the Joint Chiefs of Staff (JCS). These areas are: force enhancement, space control, force application, and space support.

Under **force enhancement**, the NSSP directs the national security space sector to:

> ...develop, operate, and maintain space systems and develop plans and architectures to meet the requirements of operational land, sea, and air forces through all levels of conflict commensurate with their intended use. [Ref. 3:p. 8]

In other words, the objective of force enhancement is to improve the warfighting capabilities of terrestrial fighting forces through space-based combat support [Ref. 12:p. 1-12]. Note that this mission area's explicit call for "plans and architectures" provides a clear motivation for the development of a NSWA.

Space control requires DoD to "develop, operate, and maintain enduring space systems to ensure its freedom of action in space." Specifically, this involves a combination of space surveillance, satellite survivability, and an antisatellite capability [Ref. 3:p. 8]. This mission area seeks to ensure friendly freedom of action throughout the space medium, and to simultaneously deny any enemy the same freedom of action [Ref. 12:p. 1-13].

Force application requires DoD, consistent with treaty obligations, to pursue research, development, and planning for strategic defenses. Such defenses will be acquired and deployed "should national security conditions dictate" [Ref. 3:p. 8]. This tasking fails to address the power projection aspect of force application . Power projection is defined by JCS as attacking terrestrial targets from space. The reason for this omission appears to be that there are no capabilities nor scheduled programs in this mission area [Ref. 12:p. 1-21].

Space (mission) support obligates the national security space sector to use manned and unmanned launch vehicles, from both East and West coasts, to ensure continued access into space for US national security satellites. Furthermore, it tasks DoD to develop survivable and robust satellite command and control, processing, and data dissemination networks [Ref. 3:p. 8]. In other words, space support consists of all those activities necessary to deploy, maintain, and sustain spacecraft on orbit [Ref. 12:p. 1-12].

d. Inter-sector Space Policies

Inter-sector policies cover those policies that apply to, and are binding on, both the "national security and civil space sectors" [Ref. 3:p. 3]. the omission of the commercial space sector seems clearly a mistake, as the policy's accompanying guidelines include many references to inter-sector commercialization requirements [Ref. 3:pp. 9-10].

In any event, these policies cover such diverse subjects as space technology transfer, space debris, and space arms control policies -- all of which have potential impact on military operations in space.

3. Analysis, Issues, and Problems

The NSP outlines the nation's civil, commercial, and national security space goals in a logical and convincing way. More to the point, it makes clear that a major part of the national space effort is dedicated to national security activities, and provides the motivation for a NSWA through its component National Security Space Policy. However, there are several omissions from the National Space Policy and the NSSP that have a direct impact on the development of a NSWA.

First, there are no explicit inter-sector guidelines that cover the transfer of control of appropriate civil and commercial space activities to DoD during times of war. For example, what is the minimum acceptable level of civil space communications during war? Under what circumstances might control of US commercial communications satellites or satellite receiving antennas be transferred to DoD? What are the mechanisms for such a transfer? Perhaps a Civil Reserve Satellite Fleet, analogous to the airlines' CRAF (Civil Reserve Aircraft Fleet), could be implemented to cover these problems. In any event, the NSP seems the proper forum for these types of guidelines. At the very least, its inter-sector policies should identify the government agency

responsible for such planning, and then task that agency to carry it out.

Similarly, there are no clear-cut guidelines explaining the circumstances under which DoD might deny otherwise available commercial services during times of conflict. Two examples come to mind: the Global Positioning System and the LandSat Program.

The GPS, discussed in the first chapter, transmits in two different modes. The encrypted mode, intended for use by US and allied military forces, will offer (among other things) location accuracies no worse than 16 meters spherical error probability (sep). The unencrypted mode, available to anyone with a commercial receiver, will normally provide user locations with accuracies within 70 meters sep [Ref. 27:p. 23]. The usefulness of even the 70 meter service is such that there is now a trade magazine dedicated solely to GPS technology spin-offs and commercial applications [Ref. 28]. The problem is, there are also many military uses for the unencrypted GPS signal, perhaps chief among them land navigation in close or desolate terrain. To prevent an adversary from gaining any benefit from the GPS, DoD may tamper with the unencrypted GPS signal to further degrade its accuracy [Ref. 13:p. 2-1]. But under what circumstances will this occur? Will DoD have the freedom to tamper with the GPS signal on its own authority? Would a counterinsurgency operation prompt the denial of 70 meter service? How much

notice could commercial users expect to receive before service is denied?

Similar questions arise when considering LandSat. LandSat spacecraft are owned by the US government but are managed by the Earth Observation Satellite Company in Lanham, Maryland. The spacecraft collect digital imagery in seven different spectral bands, providing any paying customer with customized views of the earth. Depending on the bands used, the images can highlight important features of a region and provide a variety of information with commercial applications: soil water content, crop production, drought effects, etc. [Ref. 29:pp. 55-56]. However, the images also have widespread military applications. According to one Deputy CINC of the US Space Command, LandSat has:

> ...paved the way for a revolution in amphibious and strike warfare. By identifying terrain characteristics...and camouflage techniques, the probability of success of special force and amphibious assault force missions or land warfare can be greatly increased. [Ref. 30:p. 14]

Given its military usefulness, would LandSat images be available to commercial users during times of conflict? Or would its operation be dedicated solely to US military support? The NSP's inter-sector policies need not attempt to list every possible scenario that might lead to the denial of government space services that might otherwise be commercially available. However, it should at least address all services

that could potentially be affected, as well as the general policy guidelines for such moves.

Another omission in the National Security Space Policy has a more direct impact on the development of a NSWA, as well as other supporting security space architectures. Although the NSSP explicitly calls for the development of "plans and architectures" to meet the requirements of "operational" warfighting forces, it fails to answer the following obvious question: how many and what types of architectures will fulfill this tasking?

One answer to this question evolves by taking a new look at the mission areas in the NSSP from the perspective of the architectural concepts developed in the previous chapter. Recall that an architecture is a set of interrelated decision makers, with an associated information flow, performing assigned missions within a common environment. By identifying different sets of decision makers, operating environments, or design missions, the general outlines of separate national security space architectures should be revealed.

As its name states, the NSWA is a warfighting architecture; its design environment is war. As such, its missions should be ruthlessly focused on one thing: how to shape the climate of combat in such a way as to create a relative advantage in battle. The NSWA itself is not concerned with how space support satellites are lofted into orbit, even though its effectiveness is directly affected by

the ability to accomplish this task. Nor is it concerned with research and development or design activities, even though both activities will eventually impact on the space support abilities at hand. The NSWA is focused on the combat commander and his forces, and how they expect or intend to use space to prevail in terrestrial combat. Accordingly, the NSWA's baseline combat missions include force enhancement, space control, and the operational (as opposed to the research and development) aspects of force enhancement.

As was alluded to in the previous paragraph, the space support mission is excluded from the NSWA. There are two reasons for this. First, space support is what a warfighter would regard as an "implied mission." If the NSSP calls for space-based support for terrestrial operations, then warfighting commanders will naturally expect that the capability to launch, operate, and maintain the appropriate space systems will follow. More importantly, both the decision makers and the environment for the space support mission are different enough from those found in the NSWA to warrant a related, but separate Space Mission Support Architecture (SMSA). The design missions for the SMSA would mirror the space support missions outlined in the NSSP.

Similarly, the research and development activities referred to as in the NSSP's force application mission clearly call for a separate Space Research, Development, and Acquisition Architecture (SRDAA). The engineering,

purchasing, and contracting environment is distinct from both the combat environment of the NSWA and the space mission support environment of the SMSA. The SRDAA has two design missions: to "preserve and enhance...technology areas having the greatest potential to advance military space capabilities beneficial to national security" [Ref. 31:p. 2]; and the development, design, and acquisition of national security space systems.

There is one final national security space architecture that is less apparent than the previous three, but just as important to gaining a full picture of the national security space effort. Note that the NSSP assigns responsibility for the space control and force application missions to DoD, while it tasks the "national security space sector" with the responsibility for force enhancement and space support. Since DoD is obviously a component part of the national security space sector, this wording implies that another agency or program is involved in providing space support to warfighting forces. That other program is the SSRSP. The final national security space architecture is the Space-based Strategic Reconnaissance/Surveillance Architecture (SSRSA).

Just like any other architecture, the SSRSA should be built around clearly stated missions. For example, peacetime SSRSP security missions could include warning of aerospace attack upon the US; arms control and treaty verification;

crisis monitoring; technical intelligence; and support of drug interdiction operations. In the author's opinion, the National Space Policy, in the form of its NSSP, seems the proper forum to list these missions, especially in light of their vital contribution to the nation's well being and overall security. The advocacy of the use of US space capabilities to advance the cause of peace on earth is long overdue. In support of this contention, one has only to review the original motivation behind classifying the existence of the SSRSP, and consider the changes that have since occurred.

In 1954, the United States was losing the strategic information war. The Eisenhower Administration, faced with an increasingly belligerent, nuclear-armed Soviet Union, had no reliable way to penetrate the "Iron Curtain" and develop useful strategic intelligence. The National Intelligence Community was reduced to sending high altitude, camera-equipped balloons across the eastern Soviet border, with the hope of recovering them eight to ten days later in Alaska, Japan, or the Bering Sea. Code named "Moby Dick," the balloon program was wholly unreliable. Of the 516 balloons launched, only 40 returned photos, covering only eight per cent of the Sino-Soviet landmass [Ref. 32:p. 13]. Clearly, the amount and reliability of information concerning the only enemy thought capable of destroying the US would have to be increased.

To help him solve this problem, President Eisenhower established a Technological Capabilities Panel (TCP), headed by James R. Killian, Jr., then president of MIT. The TCP's final report, "Meeting the Threat of Surprise Attack," was published in 1955. It included one whole section on the development of highly advanced intelligence collection systems, among them earth circling satellites [Ref. 7:pp. 66-67].

Although the findings of the "Killian Report" were considered highly sensitive at the time, by the end of the 1950's, the government's intention to pursue a space-based reconnaissance capability was openly acknowledged. For example, Aviation Week ran a series of articles in 1959 describing the technical issues surrounding space-based photoreconnaissance. These articles were based on a report entitled "Fundamental Considerations of the Reconnaissance from a Satellite," prepared by the Space Reconnaissance Department of Allen B. DuPont Laboratories [see Ref. 33]. And in 1960, in an unclassified hearing before the US House of Representatives concerning "Defense Space Interests," the Secretary of Defense acknowledged that the US Air Force had been assigned the responsibility to develop a satellite reconnaissance system, code-name SAMOS [Ref. 34:p. 10]. At its inception, the SSRSP was, if not a "white" program, at least "medium gray" [Ref. 7:p. 107].

This changed abruptly with the onset of the Kennedy Administration. In 1960, the Soviet Union began mounting increasingly strident attacks on the legitimacy of US space-based reconnaissance. Fearing a legal finding that satellite overflights constituted a violation of international law, President Kennedy's National Security Advisor ordered a complete black-out on information about the fledgling SSRSP in January 1961. In other words, the original motivation behind classifying SSRSP operations was to "keep spy sats from being shot down by political action." However, this black-out was never intended to be indefinite. Once the political and legal dangers facing space-based reconnaissance had been removed, the responsible officials felt that the existence of the SSRSP should be publicly acknowledged, and "explained in terms of the overall objectives of, and necessity for that program" [Ref. 35:pp. 346-348].

Unfortunately, the secrecy surrounding the SSRSP assumed a life of its own. Such was the depth of security that it was not until 1978 that government officials or military officers could even acknowledge that US space-based reconnaissance programs existed [Ref. 32:p. 123]. And to this day, the author knows of no official government publication or document that explicitly acknowledges the missions of the SSRSP.

In light of the many changes that have occurred since 1961, such stubborn failure to tout the national value of the

SSRSP seems counterproductive. As early as 1963, the Soviet Union had agreed in principle to legitimize observation from space. This was for the simple reason that it, too, had perfected reconnaissance satellites [Ref. 35:p. 348]. In any event, commercial remote sensing satellites such as LandSat and France's SPOT have established once and for all that imaging from outer space without a target country's permission does not constitute a violation of international law. Moreover, several detailed books, among them William Burrough's Deep Black [Ref. 7] and Jefferey Richelson's America's Secret Eyes in Space [Ref. 36], have reported on operations about the SSRSP. While the information contained in these books may or may not be accurate in detail, both clearly indicate the intent of the SSRSP. Based on the new international security environment and the relaxation of tensions with the Soviet Union, it would seem that the time is right to "explain the SSRSP in terms of its overall objectives." The NSSP is the logical means to this end.

C. NATIONAL SECURITY SPACE CAMPAIGN PLANS

1. General

During times of peace, the most important task facing the national security space sector is to prepare for war. Of course, some components of the sector, most notably the SSRSP and the space combat support program, have important peacetime roles. However, should war break out, the efforts of the

entire sector would be brought to bear to speed its termination. Peacetime activities of the security space sector should therefore focus on achieving a high level of training, flexibility in organization and equipment, **and above all**, a close relationship with those it is designed to support -- the warfighters [Ref. 37:p. 41]. Should these interrelated goals be achieved, the stage will be set to truly integrate space-based support into the combat operations of US fighting forces.

Recall that the NSSP tasks the national security space sector to develop "plans and architectures" to meet the space support requirements of operational forces. Whether intended or not, the sequence of this tasking is especially appropriate. Plans play a fundamental role in the preparation for war. Given the broad objectives of providing space-based intelligence support to the NCA, space-based combat support to US fighting forces, space mission support, and space-related research and development, the next step is to plan campaigns to reach them. For the purposes of this discussion, a campaign plan is "a progressive sequence of attainable goals to attain an objective within a specified time" [Ref. 37:p. 41].

National security space campaign plans aim to ease the transition between the broad objectives outlined in the (modified) NSSP and the four associated national security space architectures. Each plan would focus the efforts of the

proper decision makers on things such as training, education, organization, and equipment design or acquisition [Ref. 37:p. 41]. Moreover, they would provide important guidelines and list any constraints for the development of their associated national security space architectures. Just as the architectures seek to establish unity of effort in the accomplishment of a common mission, so too would the combination of the four campaign plans forge cohesiveness within the security space sector as a whole.

Logic and unity of effort dictate that during times of war, DoD would assume control of all SSRSP on-orbit systems as well as all space mission support operations. Therefore, an important component of this sublevel is inter-program coordination plans. These coordination plans would serve a similar purpose to the inter-sector policies found at the national policy sublevel.

2. The DoD Space Campaign Plan

The DoD Space Campaign Plan (DoDSCP), associated as it is to the NSWA, would replace the DoD Military Space Policy [Ref. 31]. This policy seems redundant; with the exception of providing more useful definitions of the four space mission areas, it basically regurgitates information found in the NSSP. It lacks any specific guidance on how services should construct their own space warfighting plans and architectures; it fails to prioritize national space missions; it contains no information on training or education about space support;

and it establishes no intermediate objectives or time lines for the development of important space combat support capabilities. The DoDSCP would cover these important items and more, providing a clear starting point for the development of a NSWA. In addition, the DoDSCP would consolidate and include as its appendices the numerous publications that now cover space-based support; i.e., the JTENS manual [Ref. 8].

3. The National Intelligence Community Space Campaign Plan

The National Intelligence Community Space Campaign Plan (NICSCP) would cover, in addition to peacetime operations of the SSRSP, the intended roles and missions of the SSRSP during times of war. Due to the extraordinary sensitivity of these operations, a large part of the NICSCP would be compartmented. However, for the TENCAP attitude to be overcome the NIC must be more forthcoming about its basic combat support capabilities. It is true that great strides have been made in the past several years in making more of the information derived from the SSRSP available for exploitation by the combat forces. But how can one expect national reconnaissance capabilities to be fully integrated into combat operations if even the must rudimentary knowledge about SSRSP assets is denied to the fighting forces? For example, naval officers can read about specific capabilities of Soviet reconnaissance systems in the Naval Space Master Plan -- at the SECRET level. This knowledge is critical to integrate

evasion and deception tactics into daily naval operations. Meanwhile, any explicit reference to US overhead reconnaissance platforms is compartmented! As long as policies such as this persist, doubts like those expressed by Captain Walters in Chapter I will be difficult to overcome.

It should be stressed that the author is in no way advocating an open-ended release of sensitive information regarding the specific operations of SSRSP. But restricted release of general capabilities seems long overdue. Top officials now routinely refer to overhead assets. For example, Air Force General Donald Hard, the Air Force's Director of Space and Strategic Defense Initiative programs, outlined in an August 1990 speech a program named "Constant Source." The program involves using special mobile terminals to provide tactical commanders with overhead imagery in near real time [Ref. 38:p. 1]. Moreover, the general capabilities of some space systems are widely known. The Soviet Union now offers commercial satellite photography with two-meter resolution [Ref. 39:p. 1], and expects to offer synthetic aperture radar imagery with 15-meter resolution in July 1990 [Ref. 40:p. 8]. And several digital images taken from US space sensors have either been leaked or published, providing ample evidence about their existence, clarity, and sophistication [see for example Ref. 32:pp. 138-141].

If these facts were not enough, the Soviet Union obtained a technical manual of one of the most modern US

photoreconnaissance satellites. Dr. Leslie Dirks, head of the CIA Directorate responsible for developing the satellite, has said that the manual contained the satellite's:

> characteristics, capabilities, and limitations... describes the process of photography employed and illustrates the quality of photos and the process used in passing the product along to the users of the system...and describes the limitation in geographic coverage. [Ref. 7:p. 22]

In this author's opinion, the benefit of withholding information that is readily available to the enemy is not worth the increased level of doubt it engenders in the warfighting forces. A NICSCP would seem to be the most logical place to provide this information.

4. The National Space Support Campaign Plan

The National Space Support Campaign Plan (NSSCP) would outline all relevant guidelines concerning the launch, operation, and maintenance of national security space systems. The plan would cover such things as time lines for availability of new launch or other support systems; education requirements for space support officers; and specific space support capabilities such as launch system availability and turn-around times, on-orbit sparing, etc. The aim of the plan, like the NICSCP, would be to focus in on how space mission support operations interact with and support the wartime functions of the NSWA.

5. The National Space Research, Development, and Acquisition Campaign Plan

The National Space Research, Development, and Acquisition Campaign Plan (NSRDACP) would outline all combat support functions that could be feasibly accomplished from space. As such, it would serve as a sounding board for space-based combat support concepts. The NSRDACP would also cover such diverse subjects as technology transfer, contracting, and design guidelines. It would also develop timelines for the initial operating capabilities of space assets developed to support the aforementioned "operational" architectures. An additional function might be to track world-wide space technology development, and to make recommendations to the NIC as to when compartmentation of specific space technologies could be discontinued without jeopardizing national security.

6. Inter-campaign Coordination Plans

Inter-campaign coordination plans would be absolutely critical to ensure the national security space sector's transition from peacetime to wartime operations. These plans, should include, at a minimum, concrete guidelines outlining the transfer of control of SSRSP assets to DoD in times of crisis. The plans should also explicitly state expected allocations of wartime space-based combat support. For example, assume the SSRSP is capable of provide x images per day. Inter-program plans should set the tentative number of images that would be allocated in support of strategic,

operational, and tactical commanders (to be fully defined later). This would in turn allow the services and the warfighting commanders to plan on how to best utilize the images on a force-wide basis, and help to build realistic expectations about the availability of space-based support.

Another important component of these plans would be peacetime exercise guidelines. To test DoD procedures for the assumption of control of all US security space assets -- to include those of the SSRSP as well as appropriate commercial and civil spacecraft -- inter-program plans would include national level space support exercises. Such exercises, made in conjunction with peacetime military operations, would identify control problems and other shortfalls in the NSWA, increase the confidence of combat commanders about the availability of space-based support, and allow the services to fine tune their individual space warfighting doctrines.

D. SUMMARY

Before a National Space Warfighting Architecture can be built, two important questions must be answered: what are its design missions and how is it related to other national security space architectures? Figure 2 provides a visual summary and review of the author's answer to these questions.

Although the NSWA is only one of four interrelated national security space architectures, it is the first among

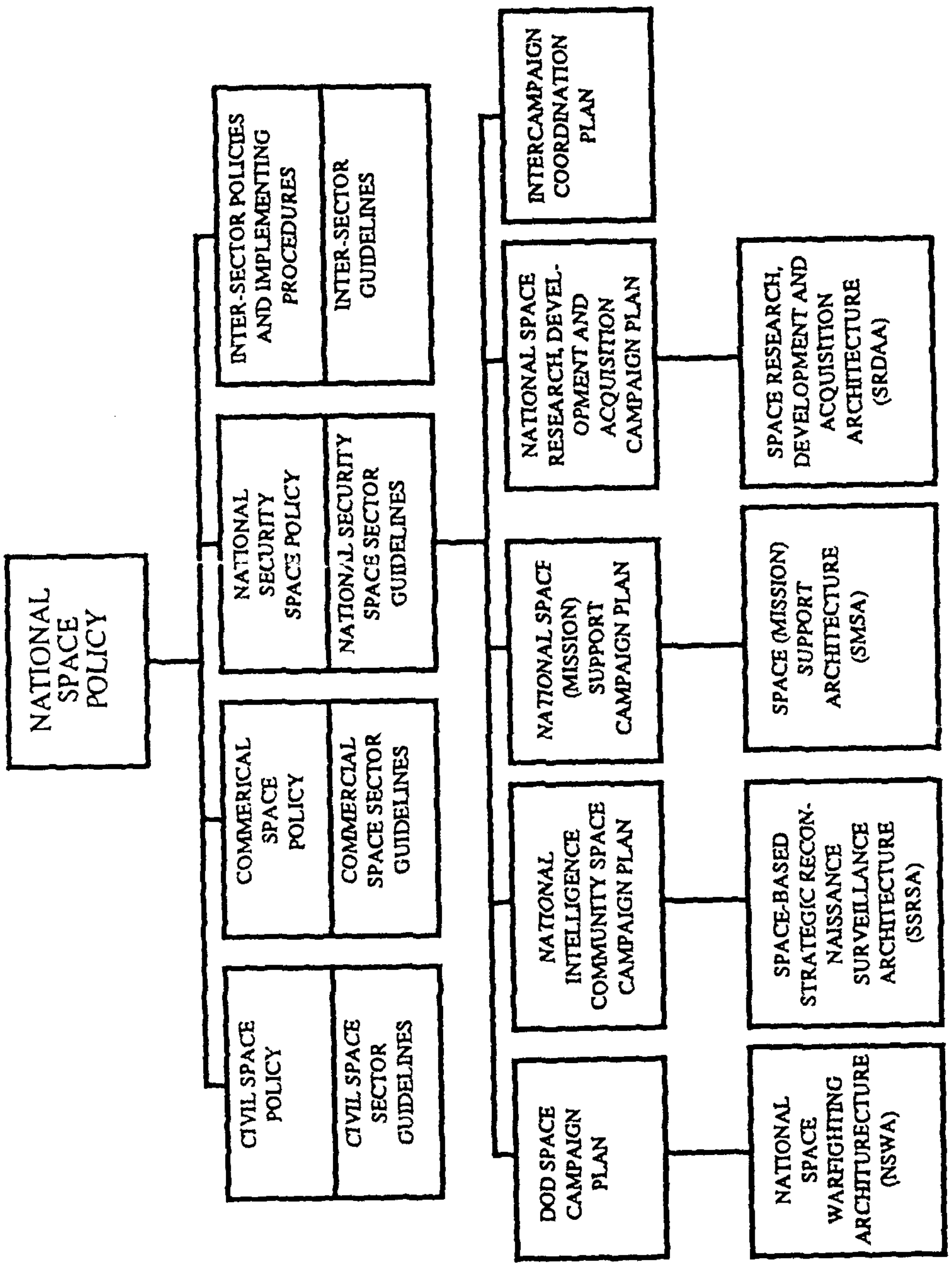

Figure 2. The National Security Space Program

equals. Its baseline combat missions, derived from an analysis of the NSSP, include force enhancement, space control, and force application. It seems clear that these missions drive the requirements of both the Space Mission Support and Space Research, Development, and Acquisition Architectures. And in times of war, the SSRSA should become an integral part of the warfighting architecture. Therefore, the development of a NSWA would seem to be a logical first step toward the integration of space-based combat support into the daily operations of terrestrial combat forces.

Having fashioned the first two of the NSWA's nine essential building blocks, it is now time to begin on the third. The next order of business is therefore to consider the NSWA's unique and dangerous operating environment: war.

IV. WAR: THE DESPERATE GAMBLE

> War is a matter of vital importance to the state; the province of life and death; the road to survival or ruin. It is mandatory that it be thoroughly studies. [Ref. 41:p. 63]
>
> Sun Tzu, 4th Century, B.C.

A. INTRODUCTION

For all of its impressive technical capabilities, the national security space constellation is not about science or technology. Discussions about orbital configurations, ground footprints, resolution limits and signal fidelity, while important, miss the crux of its mission. The national security space constellation is about war -- either to aid in its prevention or to assist in its termination. To be useful, a National Space Warfighting Architecture must therefore focus on war and warfighting concepts. The purpose of this chapter is to provide a short look at the nature of war. The ideas presented herein will guide the later development of warfighting concepts that can be used to build the framework for a relevant and practical National Space Warfighting Architecture.[1]

[1]The conceptual guide for this chapter and the next is the Marine Corps' doctrinal treatise on war, FMFM-1, Warfighting. Although many of the thoughts contained herein are similar to those in that work, the author was not constrained by its concepts or conclusions.

B. WAR DEFINED

Webster defines war as "open armed conflict between nations or states, or between parties in the same state, carried on by force of arms for various purposes" [Ref. 19:p. 2059]. However, this traditional definition falls to capture war's true essence. Although his writings are now over 150 years old, Carl von Clausewitz seems to capture this essence best:

> I shall not begin by formulating a crude, journalistic definition of war, but go straight to the heart of the matter, to the duel. War is nothing more than but a duel on a larger scale. Countless duels go to make up war, but a picture of it as a whole can be formed by imagining a pair of wrestlers. Each tries through physical force to compel the other to do his will; his **immediate** aim is to **throw** his opponent in order to make him incapable of further resistance. **War is thus an act of force to compel our enemy to do our will** (original emphasis).
> [Ref. 42:p. 75]

While this oft-quoted analogy is rich in meaning, it represents Clausewitz's view of war's theoretical extreme. Clausewitz later writes:

> If we now consider briefly the subjective nature of war -- the means by which war has to be fought -- it will look more than ever like a **gamble**...From the very start there is an interplay of possibilities, probabilities, good luck and bad that weaves its way through the length and breadth of the tapestry. In the whole range of human activities, war most closely resembles a **game of cards** (emphasis added).
> [Ref. 42:pp. 85-86]

Taken together, these two simple yet elegant passages point toward a more meaningful definition of war. War is a clash involving the use and threat of armed violence between

two living forces, each possessing independent, implacable and irreconcilable wills, and both subject to the skill, guesswork, and luck associated with any game of chance. The larger "duel" of war, the gamble, is made up of countless smaller duels, the individual hands of cards. While the outcome of a specific hand may not impinge on the gamble's final outcome, the cumulative effect of all hands most certainly does. War becomes a straightforward attempt to win the gamble -- to impose one's will on another -- by making the opponent incapable of further play. There are two ways to accomplished this aim. The first is to physically take the opponent's stake -- through the overt use of military force. The second is to psychologically take the opponent's stake -- through the bluff or threat of military force.

The view of war as a contest between two "living forces" vice two nations may be more appropriate now than even Clausewitz intended. Some theorists envision a new generation of war that will be fought outside the familiar nation-state framework. In their view, a nonnational entity, united by ideology, religion, or greed, may become the most likely enemy in the future. "The "Drug War" is offered as an example to support this theory [Ref. 43:p. 26].

The appearance of nonnational enemies will only increase the probability that states of war -- defined as formal political declarations of armed hostilities between two or more nations -- will be less likely in the future. The US

has declared war only five times in its history, the last being World War II [Ref. 37:p. 79]. Since that time, American forces have fought in two major undeclared wars and have been involved in numerous smaller conflicts. The definition of war as a clash between two hostile wills that involves the use and threat of armed violence and is subject to the effects of chance is an enduring one.

C. WAR AS AN INSTRUMENT OF POLICY

> War is not pastime; it is no mere joy in daring and winning, no place for irresponsible enthusiasts. It is a serious means to a serious end, and all of its colorful resemblance to a game of chance...(is) merely its special characteristic. [Ref. 42:p. 86]

For all of his elegant analogies, Clausewitz recognized that war is "a serious means to a serious end;" it is not fought for its own sake. For an armed clash to occur, some motive must drive the two opponents toward an irreconcilable and violent argument. The driving motive can be found in the political aims of the opponents, which are mutually perceived as hostile. War's political aims determine both the military objectives and the amount of effort and resources expended by each side. The single most important factor that moderates war's violent theoretical extreme is that war is a "**political** instrument, a continuation of political activity by other means" [Ref. 42:pp. 80-87].

Clausewitz saw the total phenomenon of war as a "remarkable trinity," consisting of a nation's people, its

government, and its commanders and armies. The people are the source of the war's passion, a "blind natural force" that provides war with its motive. They decide when to risk the gamble and are avid followers of its progress. The commander and his army are responsible for playing the individual hands over the course of the game. They, more than any other, feel the pressure of facing a skilled and determined opponent, as well as the unpredictable impact of chance and luck. Governments are responsible for the "rational" side of war -- its political aims. They set the gamble's perceived realistic goals, allocate stakes among players, placate the people when luck runs bad, and restrain commanders when luck turns good. Their ultimate responsibility is to decide when it's in the nation's best interest to start and quit the gamble [Ref. 44:p. 97].

Once again, Clausewitz's talent for analogies brings out the fundamental importance of war's policy aims. War is largely an irrational act. It is one part passion, one part chance, and one part reason; two of its three elements are by definition unrestrained and unpredictable. Without the guiding moderation of reason, expressed in the political objectives fashioned by the government, the unbridled power of the people's passions or the reckless betting by warfighting commanders might very well cause mortal damage to a nation's interests [Ref. 44:pp. 97-98].

D. THE GAMBLE'S KEY ACTOR: THE COMMANDER

1. The Commander in War

In Clausewitz's remarkable trinity, the people stoke the passionate engine of war, the government lays the track of national interest, but only the commander decides how to drive the engine in combat [Ref. 44:p. 100]. As a result, the violent competition between opposing warfighting commanders can often be viewed as a microcosm of war. Be it a strategic commander-in-chief or a squad leader, a commander finds himself across the "gambling table" from a determined and skilled opponent with an identical goal: to make his enemy incapable of further play. How the warfighting leader plays his cards often determines the fate of both the people and their government. Theoretical studies of war, the Sun Tzu to Clausewitz, have therefore, focused on the commander and his role in war's gamble. This thesis will follow suit.

Focusing on the commander's role in war serves two further important purposes. First, command has been defined as a "function that has to be exercised, more or less continuously, if an army is to exist and operate...Few other functions...are as important in both respects, existence and operation" [Ref. 45:p. 5]. Concepts based on command are relevant to all services, at every echelon of leadership, and for all types of warfare. Second, focusing on a commander, rather than some abstract "living force," drives home the essential importance of the **human** dimension in war:

> It is the human dimension which infuses war with its intangible moral factors. War is shaped by human nature and is subject to the complexities, inconsistences, and peculiarities which characterize human behavior. Since war is an act of violence based on irreconcilable differences, it will invariably inflame and be shaped by human emotions. [Ref. 37:p. 10]

2. The First Law of Command: Win Quickly

It bears repeating that for all of its similarities to a gamble, war has vast additional different qualities. For this reason: the "chips" are men's lives and a nation's future. The result of hands both won and lost is violence, death, and widespread suffering. Therefore, the first and foremost law of command is to win the gamble as quickly as possible. Although over 2500 years old, Sun Tzu's words are still relevant:

> Thus, while we have heard of blundering swiftness in war, we have not yet seen a clever operation that was prolonged.... Hence, what is essential in war is victory, not prolonged operation. And therefore a general who understands war is the minister of the people's fate, and arbiter of the nation's destiny. [Ref. 41:pp. 73 and 76]

3. The Second Law of Command: You Can't Win If You Don't Play

After all the posturing, betting, and bluffing is done, a gamble is decided by the play of the cards. And so it is in war. In the end, there is only one means toward victory: battle. Armed conflict may arise out of the clash between two hostile political entities, each bent on imposing his own desires or values on the other; it may involve entire alliances of nations or merely parties within the same state;

it may be of long duration or consist of a short, violent explosion. In any case, a fundamental concept of war is that everything must "originally derive from combat...The end for which a soldier is recruited...armed and trained, the whole object of his...marching is simply that he should fight at the right time and place" [Ref. 42:p. 95]. To win a gamble quickly, at the very least a commander must understand the nuances of the game, and effectively play his hands. In other words, he must understand the factors that shape the climate of combat and survive the storm of battle.

E. THE CLIMATE OF COMBAT

1. The Atmosphere of War: Chance

The climate of combat is modulated and formed in the very atmosphere that pervades the gamble: chance. Chance is the inexplicable or random event whose cause is either inapparent or unconnected to its effects [Ref. 44:p. 104]. While its touch is felt in all of life's endeavors, its effects are especially felt in war: "No other human activity is so universally bound up with chance," and therefore, "guesswork and luck play a great part in war" [Ref. 42:p. 85]. As a result, the best dealt hand, no matter how skillfully or forcefully played, may still not be enough in the eyes of "lady luck," the neutral arbiter of the gamble.

There are two basic responses to chance's presence in war. The first is that it is unwelcome, an "intruder" that

conspires to interfere with the quest for victory [Ref. 42:p. 101]. A commander is expected to do everything possible to minimize its impact on the gamble's final outcome. As a result, this view often embraces rules or systems that, if diligently applied, should "guarantee" victory. These rules rest upon the notion that war, like nature, proceeds according to certain regularities [Ref. 46:p. 41]. Chance, when it strikes, serves only to magnify the more serious mistake of misapplying or misunderstanding these regularities. In the first view, victory in war is seen less as a product of a commander's triumphant will and more the predictable outcome of rules well applied.

The second view is based on the belief that a commander's unique decisions are more important to war's outcome than to his mindless application of a list of simple rules. Instead of a betrayer of hopes and plans, chance is seen as the bearer of opportunities to quick victory, and is therefore welcomed, even relished, by a receptive and creative leader [Ref. 44:p. 98]. This view sees war as a such a complex and unpredictable undertaking, so intertwined with the peculiarities of chance and the time and place of each encounter, that attempts to establish maxims or rules according to which war proceeds and should be followed are pointless [Ref. 46:p. 41]. In the second view, the outcome of war turns directly on the character of the commander, which determines the "scope which the play of courage and talent

will enjoy in the realm of probability and chance" [Clausewitz, as cited in Ref. 44:p. 97]. The author subscribes to this second view of chance. That view will predominate in the ideas and concepts presented in this thesis.

2. War's Climatic Variables

The climate of war comprises five different variables. The variables are ever-present, but also ever-changing, and therefore unpredictable. They are: armed violence, danger, exertion, (the commander's) uncertainty, and friction.

The climate of war is characterized by armed violence. War is a violent collision between two implacable opposing wills -- where there is only one will there is massacre, not combat [Ref. 45:p. 266]. It is the violent interaction and interplay between these two opposing wills that, more than any other variable, shapes the unpredictable nature of the combat climate:

> The...attribute of military action is that it must expect positive reactions, and the process of interaction that results. Here we are not concerned with the problem of calculating such reaction...but rather with the fact that the very nature of interaction is bound to make it unpredictable. The effect that any measure will have on the enemy is the most singular factor among all the particulars of action. [Ref. 42:p. 139]

Danger is a direct reflection of the climate's level of violence. Its human manifestation is fear -- the debilitating, psychological reaction to the ever-present possibility that war's gamble will be lost. In combat, there

are two types of danger and, therefore, two types of fear. The first type of danger is to one's self, when the stakes literally involve one's life. Fear in this case is the personal uncertainty and doubt that one will survive the gamble. Its cure is found in personal courage, which is not the absence of fear, but the inner, psychological strength to overcome it [Ref. 37:p. 12].

The second type of danger is to others; it occurs when a fighter is forced to risk men's lives or his nation's future in pursuit of victory. Fear in this case, is the commander's burden, the agonizing doubt that his plan is worthy of the stakes. Its cure is found in the courage to accept responsibility. A commander must possess both types of courage to succeed in war: with the first he overcomes his personal fear and accepts a seat in war's gamble; but only with the second is he able to impose a decision on his opponent [Ref. 42:p. 101]. As Sun Tzu said, "If courageous, (a general) gains victory by seizing opportunity without hesitation...If a general is not courageous, he will be unable to conquer doubts or create great plans" [Ref. 41:p. 65].

The third variable, **exertion**, reflects the demands of prolonged exposure to war's inhospitable climate. War imposes brutal physical and mental hardships on its participants; indeed the two are directly related. Physical exertion and lack of rest during combat lead quickly to physical exhaustion, which magnifies mens' perceptions of danger and

feelings of fear. The result is a sapping of mens' will to fight. S.L.A. Marshall describes this cycle quite vividly in his book Men Against Fire [see Ref. 47]. Again, though exertion affects all combatants, it imposes special demands on the commander. The commander must always be aware of his army's limit of endurance, and he must have the special courage to push his men to this limit when necessary; the strength of will to drive men beyond this limit when victory is near; and the intelligence to know when opportunities must be foregone to allow his men the chance to recuperate [Ref. 42:p. 115].

Next to the enemy, **uncertainty** is the most serious obstacle that a commander must conquer if he is to function, much less flourish, in the climate of war. This uncertainty is separate from the doubt caused by fear, although both fear of death and fear to take responsibility combine to heighten its effects. Nor is it the uncertainly associated with chance, since chance is unpredictable and largely unmanageable. It is the uncertainty inherent in the violent, dangerous, and exhausting game or war, as the commander weighs his own hand and considers his opponent's possible moves against him. Uncertainty is the commander's psychological state of discomfort from confusion or lack of information about his enemy [Ref. 44:p. 104].

Quick victory would be relatively assured if a leader is lucky enough to know his enemy's hand, but few opponents

are obliged to tip their cards. Before a commander acts, he is compelled to gather what information is available about the enemy's playing style, the strengths of the enemy and friendly hands, the potential place of the gamble, and the overall risks of playing. Command can thus be seen as a quest for certainty: certainty about the strength and intentions of the enemy's forces; certainty about the position and state of friendly forces; and certainty about the exact place and time where the battle may be joined [Ref. 45:p. 264].

But certainty is elusive. Says Clausewitz, "War is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of greater or lesser uncertainty" [Ref. 42:p. 101]. This is the so-called fog of war, the impenetrable haze which ensures that a commander's plans will be based on incomplete and inaccurate impressions about his foe. The best any commander can do is to gather as much information as possible within a limited period of time, to weigh is own hand, and to predict his enemy's intentions and actions. How many cards did he take? Is he disposed to bluff? How critical would the loss of a single hand affect the outcome of the gamble? Based on the answers to these questions and the risks they entail, the commander devises a plan and acts accordingly.

A commander's plan reflects one of four responses to uncertainty. The first is manifested by a fear to take

responsibility, the lack of will to predict the enemy's course of action or to devise a strategy:

> ...a general unable to estimate his capabilities... when faced with the opportunity to engage the enemy will advance in a stumbling manner, looking anxiously first to his right and then to his left, and be unable to produce a plan. [Ref. 41:p. 87]

The second response is made by a commander who has little knowledge of the enemy or his playing style, but who has the courage to accept responsibility and to put aside concern for what cannot be controlled. The mental act of leaving inevitable contingencies to chance frees his energies to concentrate on dictating the action. This response is an explicit rejection of passivity. It is based on Napoleon's advice to "Engage the enemy and see what happens" [Ref. 44:p. 108]. The rejection of passivity is a daring act in its own right; since the commander bases his plans only on his own hand and the neutral element of chance, he willingly accepts fifty-fifty odds on winning the gamble [Ref. 41:p. 84].

A bold response is the response of a "card counter." No commander can guarantee victory. But the warfighter who has indications that the enemy's hand is weak, has knowledge and confidence in his own cards, and who has paid meticulous attention to preceding hands, is often willing to "up the ante" to take advantage of favorable opportunities that arise during play. Boldness is a daring "bet," tempered with judgment, backed up by the special courage to risk more to gain more. Boldness combines the courage to accept

responsibility and creativity to exploit a fleeting chance for victory. It "must be granted a certain power over and above successful calculations involving space, time, and magnitude of forces, for where it is superior, it will take advantage of an opponent's weakness." In other words, it is a "genuinely creative force" [Clausewitz, cited in Ref. 37:p. 34].

A reckless response is the dark side of boldness. It is the sign of a commander who believes chance is fair as well as random. Since chance produces runs of events that tend to even out over time, a reckless commander is willing to bet the lives of his men and the outcome of the gamble that this "evening out" will occur on the next play [Ref. 44:p. 110]. Although chance may occasionally smile upon such schemes, recklessness represents an unjustifiable risk, wholly unworthy of the responsibility invested in a warfighting leader. Senior commanders owe it to their men to ruthlessly remove fighting leaders who exhibit reckless behavior.

If uncertainty presents the foremost obstacle to the development of a commander's plan, then **friction** presents the greatest obstacle to his plan's successful execution. Even if a commander has the courage to accept responsibility, has correctly guessed the enemy's hand, and has boldly planned to exploit the situation, there is no guarantee that his play will conform to his plan. An improper bet, an inappropriate discard, or a revealing glance of his cards may conspire to

disrupt his intended playing strategy. This is friction, the "force that makes the apparently easy so difficult" in combat [Ref. 42:p. 121].

Friction is the decremental loss of effort or intention caused by human fallibility, compounded by danger and physical exertion. Just like its mechanical counterpart, friction is the phenomenon that reduces the efficiency of the commander's war machine. Friction is itself a serious inhibitor of combat performance, but when operating within an atmosphere of chance, it can be amplified in random, unpredictable ways that can turn a simple mistake into a serious crisis. While a good commander makes every effort to minimize friction, he does not try to eliminate the inevitable. Friction sets limits on what can or cannot be done in combat, and the successful commander will make simple plans with these limits set firmly in mind. Moreover, he expects and anticipates the intervention of chance on friction, and stands ready to meet the resulting crises calmly and decisively [Ref. 44:pp. 104-105].

3. Disorder: The Climate of Combat

Disorder is nothing less than the climate of combat, the unique mixture in time of war's five climatic variables within the overall atmosphere of chance. The combat climate is nonquanitifiable; its patterns are unpredictable and capricious. Indeed, since each of its five climatic factors are in constant flux and chance is forever an unpredictable

quantity, disorder represents the infinite range of environments within which men have and will fight.

Make no mistake: the combat climate is the most dangerous, least hospitable place known to man. Within its confines the light is dim and misleading; the atmosphere oppressive and threatening; the movement difficult and slow. Disorder is what Clausewitz dubbed "general friction," the thing that impedes and fights the commander's progress toward his objectives [Ref. 42:p. 122]. Viewed in another way, disorder is the primary obstacle in the way of forging a commander's plan of action, as well as the direct cause of a plan's natural disintegration once the combat joined. It is the factor that caused the elder von Moltke to state that "No plan survives first contact with the enemy" [Moltke, cited in Ref. 48].

Like the atmosphere that shapes it, the climate of combat is a neutral surrounding -- it affects operations of friendly and enemy units alike. The longer opponents dwell within in, the greater the tendency toward chaos on both sides. Orders are misinterpreted or lost; expected actions do not take place or are bungled; newer, more certain information is received; or attractive opportunities arise that were neither predicted nor prepared for. Under these circumstances, a commander must be flexible enough to modify his original plans to exploit the inevitable, fleeting new

chances that arise in the swirling, changing currents of the climate [Ref. 37:p. 9]. As German commanders were told:

> Once a decision is made, do not deviate, except for excellent reasons. In this connection, however, one can bring about disaster by obstinately clinging to the initial decision when justifiable grounds are present for change. The true art of leadership is the ability to recognize when a new decision is required by the developments or changes to the situation. The commander should be resolute but not obstinate. [Ref. 49:p. 29]

Rather than becoming a helpless spectator, buffeted by the changing currents of disorder, a commander willing to follow this advice is able to "ride the wind," and to operate, even flourish, within the disorderly climate of combat.

F. THE STORM OF BATTLE

1. War's Means of Decision

For a commander entrusted with the responsibility to play in war's gamble, the moment of truth comes with the play of the cards. A successful commander is one who, through the skillful use of threats and acts of violence, compels his enemy to withdraw or capitulate. The means toward these ends are the storms of battle. Battles are the stepping stones that lead to either victory or defeat in the gamble; where there are no battles there is confrontation, not war. In other words, storms of battle are war's final means of decision.

Battle storms form within the climate of combat at a specific place and time. As such, chance and the five

climatic variables mix turbulently within their confines. But storms of battle are marked by higher levels of violence and cover more localized areas in time and space than the global, more constant combat climate. Just as the combat climate is marked by an infinite range of fighting environments, so too are battle storms marked by an infinite range of violence. One may resemble a tornado, a seething cauldron of almost unimaginable power and destruction; another just an approaching front, threatening violence to come. In any case, it is into the storm that a commander must order or lead his men if he is to win war's gamble.

2. Technology and the Scope of Battle

Two general measures of a battle storm's scope are its size and duration. The larger the geographic area touched by the fury of the storm, the longer its effects are felt by combatants, the higher its scope. Military history reveals that the size and length of battle storms have grown inexorably larger and longer. To understand this clear trend, it is necessary to consider the impact of technology in and on the storm of battle.

Clausewitz resisted any tendency to include material considerations in his writings on war. He said, "It is clear that weapons and equipment are not essential for the concept of fighting" [Ref. 42:p. 127]. Insofar as "fighting" is defined as a clash between two hostile wills, involving the use of armed force, and subject to the element of chance, then

Clausewitz was certainly right. War, at its essential core, is immutable and unchanging. Regardless of the material means used to pursue war's aims, chance, the climate of combat, and the storm of battle have defined the environment in which men have always fought. But clearly, technology has had some impact on war, and it is on the scope of battle that its effects have been most felt.

Battlefields are now more sprawling than Clausewitz could ever have imagined. On land, combat units have had to disperse to survive the effects of accurate, long-range, and lethal fire. The number of square meters per man in battle has grown by a factor of 400 since Clausewitz's time and by 1.45 since World War II [Ref. 45:p. 277]. On sea and in the air, the sheer size of the battlespace and similar abilities to target and engage forces from long range have opened the distance between opposing and among friendly units. This continuous, expanding pattern of dispersion has increased the breadth of battle storms by orders of magnitude above those of earlier times, and in the process, made its interior a seemingly empty place. Death now comes suddenly from long range, far from the view of the combatants, heightening their feelings of danger and fear [Ref. 47:p. 63].

Technology has expanded the duration as well as the breadth of battle storms. Night or adverse weather no longer present the formidable natural barriers to continuous operations as they have in the past. As a result, a storm's

full fury can now blow around the clock for days on end, offering little or no respite to combatants. Exertion is now a more constant, continuous drag on men fighting within the storm, increasing and prolonging their physical exhaustion, and thereby intensifying the effects of friction.

Battlefield dispersion and the elimination of two of war's natural barriers have combined to create battle storms of incredible scope. In the process, the levels of disorder within the storm are now so high and over such wide areas that the distribution between front and rear, and friendly or enemy-controlled territory, are blurred. Within the storm there are pockets of "heavy air," local concentrations of both friendly and enemy forces, and "light air," voids of relatively low concentrations. The turbulent currents of battle toss and intermix these pockets of force, creating unoccupied areas, gaps, and exposed flanks. These weaknesses offer paths to victory if they can be discerned through the fog of war and subsequently exploited [Ref. 37:p. 9].

This is easier said than done. The magnitude of disorder found within the breadth of the storm confounds attempts to combine friendly forces or coordinate their movement, quickly veils enemy vulnerabilities from view, creates friendly weaknesses and precipitates crises, and often causes unexpected, random collisions between combatants before plans can be finalized. While these conditions have always been found within the storm of battle, technology has

nevertheless caused a tremendous increase in areas affected by these conditions, and has therefore, magnified the presence of uncertainty, friction, and the effects of chance.

3. The Gamble's Fighting Rhythm

While a commander endeavors to win the gamble as quickly as possible, the incredible intensities of battle storms conspire to exhaust the opposing combatants. As a result, commanders must carefully consider when they should offer or participate in battle. War is therefore marked by flurries of violent and intense hands involving many players, followed by periods of introspection, planning, and preparation. The hands merge with those that precede and follow, creating the competitive flow and ebb of the gamble [Ref. 37:p. 8]. Opposing commanders try to influence and exploit the uneven rhythm of the gamble to their own advantage, by quickly reacting to unforeseen, fleeting opportunities. Successful commanders will, in large part, be those able to adapt and prosper in the gamble's maddening, trying, and competitive fighting rhythm.

G. THE ART OF WAR AND THE NATIONAL SPACE WARFIGHTING ARCHITECTURE

In 1936, the German Army published an Army Service manual entitled Truppenfuhrung -- Command of Troops. The introduction of the manual starts with the following passage: "War is an **art**, a free creative activity resting on scientific foundations. It makes the highest demands on men's entire

personality" [Ref. 50:p: 54]. To help understand this statement, a simple analogy is helpful. Like a weatherman, a commander has certain measurements and rules, based on the laws of science, that he can use to predict patterns in the climate of combat and to forecast the intensity of coming storms. These predictions help the commander to prepare himself and his forces for battle. But in the end, the forecast is nothing more than a "hunch," a guess about future conditions. And like the weather, once a storm hits, it is a totally unique combination of war's climatic variables, *modified by chance*, that may be totally different from what the commander anticipated. Indeed, the commander may not even have forecast its arrival. Success in the storm of combat thus never turns on the simple application of scientific rules, but instead on the art of prediction and adaptation in the face of chance and disorder. As Sun Tzu said:

> And as water shapes its flow in accordance with the ground, so an army manages its victory in accordance with the situation of the enemy. And as water has not constant form, there are in war no constant conditions. Thus one able to gain victory by modifying his tactics in accordance with the enemy situation may be said to be divine. [Ref. 41:p. 10]

Thus revealed, war is indeed an art, an activity of human intuition, guesswork, and creativity, powered by character and strength of will. The art of war is practiced by the commander, who requires an ability to peer through the fog of war and grasp the essence of a unique combat situation, the

creative ability to devise a solution that accounts for the friction of war, and the courage and strength of purpose to see it through [Ref. 37:p. 15].

The view of war as art has an important practical impact on this thesis, for it reveals the proper focus for a National Space Warfighting Architecture. The art of war is in large part the art of command. The NSWA should therefore have the warfighting commander, be it the President, a Theater Commander-in-Chief, or a MAGTF commander, as its first and primary focus. The decision to pursue a national security space capability is a policy decision approved by the government and the people, and the resulting on-orbit constellation represents a tremendous national investment in time, money, and technological capability. But the constellation does not exist for its own sake, and focusing on its characteristics rather than its mission tends to obscure this fundamental fact. The constellation exists for one reason and one reason only: to provide direct support to commanders entrusted with the responsibility to come to grips with their uncertainty and master the opportunities offered by the chance encounters that characterize war.

V. WARFIGHTING CONCEPTS

> After troops have crossed the borders, responsibility for laws and orders devolves upon the general. [Ref. 41:p. 64]
>
> Sun Tzu

A. INTRODUCTION

Chapter IV describes war, the environment of the National Space Warfighting Architecture. Building on the view of war as a violent, disorderly gamble between two human wills, this chapter develops key concepts that describe the practical art of warfighting. The intent is to identify concepts that are relevant to all levels and types of conflict; concepts that can be used to provide a unifying theme within the framework of NSWA. In the process, the author will continue to build the common vocabulary necessary to the success of any architecture.

B. DECISION AND ACTION: THE ENGINE OF WAR

War makes tremendous demands on all participants. Chance, danger, exertion, and disorder are certainly not the sole burden of the combat leader. Why then should the National Space Warfighting Architecture have as its first and primary focus the warfighting commander? For this reason: all military actions, regardless of size, are based on commanders' decisions. Outside the realm of chance, victory is a reflection of sound decisions skillfully executed [Ref. 51:p.

18]. However, as this last sentence implies, focusing on the commander in no way means overlooking the role of his forces. The two are inextricably linked. Indeed, steadfast, resolute, and brave fighting men, representing the people and united in a common purpose by their government, are the sole reason a commander exists. Armies are a commander's weapon, the means by which he can inflict damage to the enemy. But weapons, however powerful, must still be aimed and fired to have any effect. As Napoleon said, "It was not the legions which crossed the Rubicon, but Caesar" [Ref. 45:p. i].

Decision by a "Caesar," **action** by his "legions." This, in a nutshell, is the combat process that drives the engine of war. War is nothing more than the relative outcome of the combat action processes of two opposing wills. To better understand this fundamental concept, it is time to (temporarily) move out of the calculating environment of the gambling hall and into the frightening and chaotic storm of a raging gunfight.

The fight starts long before the exchange of bullets. Opposing fighters jockey for position to increase the effects of their weapons. Some elect to stay in easily defensible positions with clear fields of fire. Others elect to move toward their enemy to get off better, more accurate shots. In any event, a gunfighter is always forced to consider the enemies arrayed before him. Seldom will he have the ammunition to shoot at every conceivable target. He therefore

is forced to select the most dangerous and most important among them. He may choose to engage a single foe, perhaps several; but he always targets the ones whose loss will hurt the other side most, and always conserves his ammunition as best he can. At some point, he brings these targets under fire. He hopes to shoot at a time and from a position of his choice, but he must be ready to fire or move to protect himself if his enemy shoots first. Based on the damage he inflicts on his opponents, the gunfighter may elect to refire at his original targets, shoot at new targets that come within range, move to a new position to better his aim, or hide and reload. All the while enemy gunfighters are repeating similar decision-action cycles, blazing away in return. These repetitive, competitive cycles continue until one side is unable or unwilling to sustain the fight.

The foregoing analogy depicts the complex interaction between the combat action processes of two opposing forces. More importantly, it helps to visualize what it takes to end the duel -- the final aim of every war. Ultimately, the duel is decided by only three things: the importance of targets chosen by the opposing commanders; the damage caused to those targets by the commanders' forces; and the relative ability of the belligerents to continue the fight. Each of these factors will be discussed in turn.

C. TARGET SELECTION: THE SEARCH FOR A CRITICAL VULNERABILITY

1. A Target Defined

A commander's weapon has only so many bullets that can be fired before he has to reload or give up the duel. He therefore has two complementary goals in every gunfight: to conserve his ammunition and to win the fight as quickly as possible. The quickest way to gain an advantage and to translate that advantage into an enemy's defeat is to identify and destroy those targets that are most important to him. Therefore, within the climate of combat and the storm of battle, a commander always tries to locate and attack the enemy's most critical vulnerability [Ref. 37:p. 30].

An enemy's critical vulnerability is often mistakenly called his "center of gravity." Center of gravity -- the German work is <u>schwerpunkt</u> -- is a key term used by Clausewitz. Throughout most of his writings, he uses this term to refer either to the armies of the belligerents (which give the wrestlers in this famous analogy their centers of gravity), or to the main concentrations of opposing armies on the battlefield:

> A center of gravity is always found where the mass is concentrated most densely. It presents the most effective target for a blow; furthermore, the heaviest blow is that struck by the center of gravity...The fighting forces of each belligerent...have a certain unity and therefore...the analogy of the center of gravity can be applied...Centers of gravity will be found wherever the forces are most concentrated [Ref. 42:p. 485-486].

Unfortunately, in one part of his unfinished manuscript, Clausewitz strays from his consistency and identifies other possible centers of gravity, among them the "community of interests" within an alliance and "public opinion in a popular uprising" [Ref. 42:p. 596]. Both to prevent misunderstandings and to retain the spirit of Clausewitz's schwerpunkt, centers of gravity will be defined hereafter as a nation's or an army's greatest concentration of combat force [Ref. 52:p. 56].

A critical vulnerability is more encompassing than an enemy's center of gravity. A commander who is successful in destroying a critical vulnerability does decisive damage to the enemy's continued ability to resist his will [Ref. 37:p. 35]. Whereas the loss of his schwerpunkt may temporarily reduce an enemy's physical ability to weather the storm of battle, it may not undermine his will to continue the war. And until the enemy's will to resist is broken, the gamble remains unwon. Thus defined, an alliance's community of interests or public opinion are not centers of gravity, but may be critical vulnerabilities.

Identifying and attacking an enemy's critical vulnerability is easier said than done. The climate of combat conspires to veil this vulnerability from a commander, or, by providing only fleeting glimpses, to tantalize him to its possible presence. Moreover, any competent enemy actively tries to conceal and protect his most critical weakness. Until this key weakness is uncovered, it is necessary to

attack lesser vulnerabilities until a path to the enemy's critical vulnerability is discovered [Ref. 37:p. 35].

2. The Policy Imperative and the Spectrum of Conflict

A commander's freedom to attack targets within the storm of combat is determined by war's policy motive: "The political object is the goal, war is the means of reaching it, and the means can never be considered in isolation from their purposes" [Ref. 42:p. 87]. When the policy motive is intense (extreme) -- such as the annihilation of the enemy -- the war is more destructive and the commander's choice of targets is less restricted. When the policy motive is less intense -- such as supporting a friendly government's counterinsurgency -- the war is less destructive and the commander's choice of targets is more restricted [Ref. 37:p. 20].

The spectrum of conflict is often used to graphically portray the give and take between the intensity of the policy motive and the commander's freedom to select vulnerable targets (see Figure 3). Types of conflict that share common relationships between these two factors are placed along a continuous curve, their relative position determined by the conflict's overall level of destructiveness and the intensity of its battlestorms. The most destructive end of the curve represents the most intense policy motive and the least restrictive target selection environment: strategic nuclear

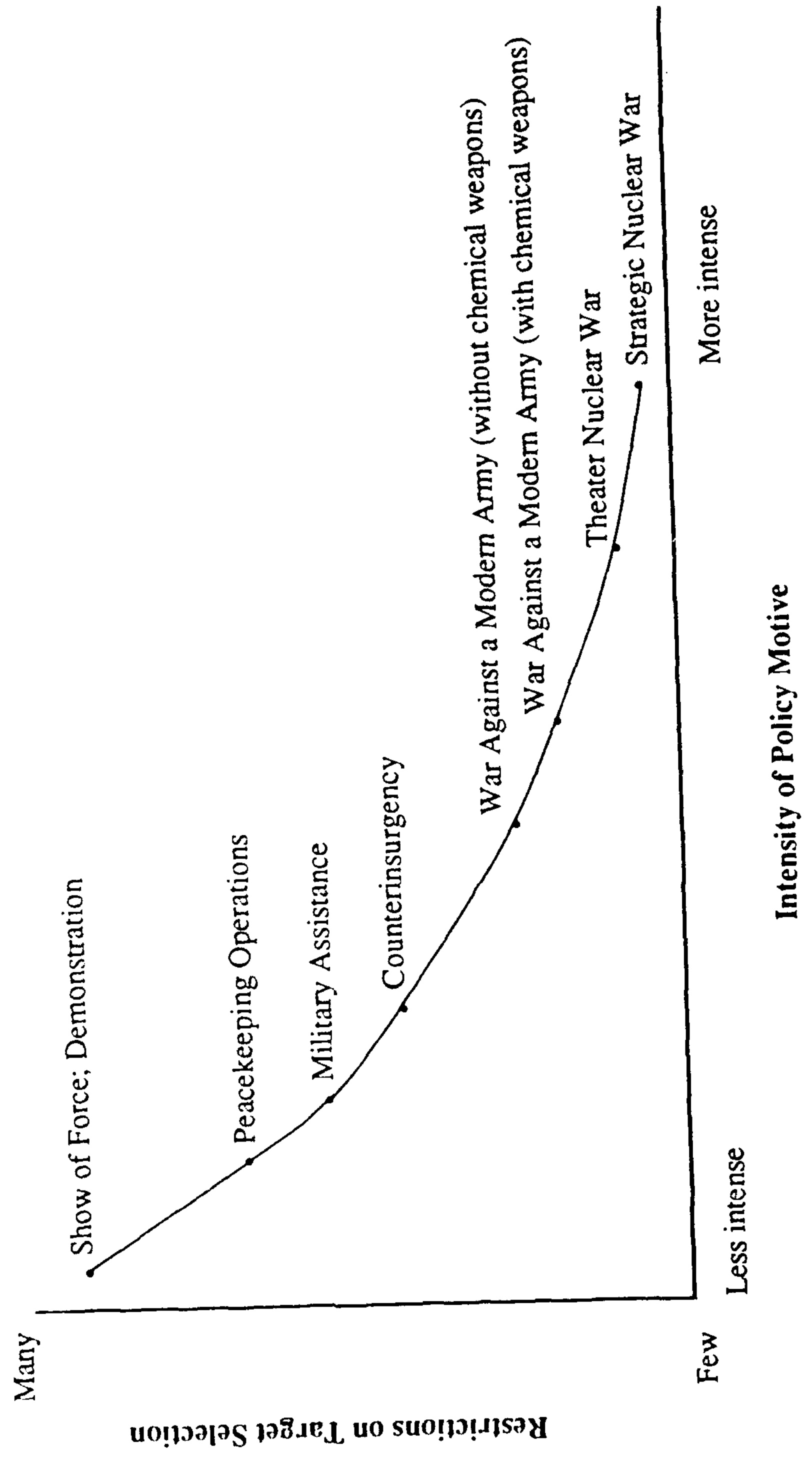

Figure 3. The Spectrum of Conflict

war. The least destructive end represents the least intense policy motive and the most restrictive target selection environment: a show of force.

When referring to conflicts with low overall levels of destructiveness, it is now common to shorten "low intensity **policy** conflict" to simply "low intensity conflict." This is a mistake. Regardless of a conflict's policy motives, the intensity of fighting **inside** its battlestorms is determined by armed violence, danger, exertion, the density of opposing forces, the tempo of operations, and the destructive potential of the weapons involved. To a warfighter at the point of contact between two forces, the battlefield seems infinitely dense, the tempo quick, the danger close and real, the weapons terrifyingly lethal. Here conflict is always high intensity. Both to maintain the fundamental link between policy and war, and to dispel any misconceptions about the intensity of fighting -- any fighting -- on the individual warfighter, the term low intensity policy conflict will be used to describe war at the "low end" of the conflict spectrum.

The practical means by which a commander's freedom of action is limited is by the use of rules of engagement (ROE's). Generally, the less intense the policy motive, the more prevalent or restrictive the ROE's. Because ROE's often protect obvious enemy vulnerabilities from attack, warfighters resent their presence, especially within the violent storm of battle [see for example Ref. 53:p. 14]. However, ROE's seldom

protect an enemy's **critical** vulnerability. If they do, there is a fundamental contradiction in the war's policy aim. Since ROE's represent the link between a war's policy motive and the individual warfighter, an ROE that prevents an attack upon an enemy's critical vulnerability is a symptom that the war's ends are at odds with its means.

3. The Levels of War (Command)

The spectrum of conflict helps to categorize a commander's freedom to attack perceived vulnerabilities. It is valid for any echelon of command. But different echelons of command perceive enemy vulnerabilities in different ways. To highlight these differences, it is helpful to talk about the levels of war, or for the purpose of this discussion, the levels ot command.

The highest level of command is occupied by the **strategic** commander-in-chief -- the nation's supreme wartime leader. He is responsible to the government and the people for winning the gamble of war. He is concerned first and foremost with war's policy aims and how the nation's military forces, in conjunction with any allied forces, can best achieve them. In this regard, he has four main tasks.

First, he selects what he perceives to be the enemy's critical vulnerability. At this high level of command the most vulnerable target is always a leg of the enemy's "remarkable trinity." It may be the most powerful leader, or perhaps a powerful opposition party, within the opposing

government. It may be the public opinion supporting the war. Perhaps it is the enemy's strategic center of gravity, or his industrial capacity, or some key technological inferiority. In any event, no coherent national (or allied) plan of action can follow until this vulnerability is identified.

Second, the CINC (in conjunction with his allies) devises a strategy to attack or exploit this critical vulnerability. The strategy is reflected in the number of individual card players that will represent him at war's "gambling table," the restrictions he imposes upon their style of play, and the complementary and supporting roles he assigns each player. In practice, the card players represent the commanders of theaters of war[2]; the restrictions are reflected in appropriate ROE's; and the roles are defined by the specific objectives assigned to each theater commander.

Third, the CINC provides each theater commander with a "stake" -- combat forces -- sufficient to accomplish their assigned goals. The stakes are drawn from the national pool of economic and military power, as provided by the government and the people. The CINC divides the sum total of national military power into theater component commands, noncombatant force groupings composed of similar types of fighting units

[2]More accurately, the card players represent the Unified and Specified commanders. However, for the purposes of this thesis, the author chooses to concentrate on the unified commanders responsible for theaters of war.

(naval, air, ground combat, etc.), and his strategic forces and reserves. He then allocates these stakes to the theater commanders according to his overall strategy of play.

Finally, the strategic CINC practices the art and science of winning wars. At this level of command, the storm of battle is marked by distant thunder; the strategic CINC is most concerned with shaping the broad climate of war in his nation's favor. Once the war begins, the CINC adds or subtracts players, shifts stakes among the players, and coordinates overall play to unmask and attack the enemy's critical vulnerability. He may elect to allocate most of his "chips" to one dominant player to attack this key weakness directly, or he may elect to apportion his chips more evenly and attack the weakness indirectly. Regardless, all of his decisions and moves are aimed at destroying this strategic critical vulnerability as quickly as possible.

The players at the tables, the theater CINC's, are **strategic warfighting** commanders. Despite their title, the theater commanders act more like gamblers than gunfighters. They are responsible to the strategic CINC for playing the actual hands of cards dealt in war's gamble. Theater CINC's use their component commands in appropriate combinations to form their "bets" -- strategic centers of gravity -- while playing the opposing theater commander. A theater CINC often decides to divide his assigned stake and play multiple hands against the enemy commander. He assigns subordinate leaders,

responsible for theaters of operations, to play these hands. Theater CINC's thus command in much the same way as the strategic CINC: they devise complementary subordinate goals, allocate forces appropriate to those goals, and coordinate overall play to win the theater gamble. Although closer to the sounds of thunder and subject to the effects of the largest and most violent battlestorms, they are most concerned with shaping the theater climate of combat.

A theater CINC tries to identify the critical vulnerability that will most help him to impose his will on the enemy theater commander. But the destruction of the enemy's critical vulnerability must do more than just win the theater duel. It must in some way unmask or exacerbate the enemy's key strategic weakness or it serves no real purpose in war. Therefore, a theater CINC's warfighting strategy is always guided and influenced by the key vulnerability identified by the strategic commander. Using this key weakness as his guide, a theater CINC can exploit fleeting opportunities or attack lesser vulnerabilities in such a way as to securely tie all military action in-theater to war's broader policy aims.

Intermediate command and action processes occur at the **operational** level of war. Theaters of operations, when activated by the theater CINC, are an organizational example of operational command. To better understand this intermediate level of command and action, it would help to

first explore the role played by war's lowest command level -- the **tactical commanders.**

Tactical commanders are gunfighters -- calculating gunfighters -- but gunfighters nonetheless. They are far less concerned with policy motives, except as they are expressed as ROE's, and far more concerned with defeating an enemy within the storm of battle. In other words, they practice the art and science of winning battles and engagements [Ref. 37:p. 23]. Engagements are clashes between opposing units, usually division size or smaller. They may be anticipated by at least one of the opposing sides, or may result from random collisions between forces on a disorderly battlefield (a "meeting" engagement). Engagements may or may not precipitate a battle -- a longer, more violent storm consisting of a series of related engagements that is characterized by higher scope, disorder, and intensity [Ref. 54:pp. 10-11].

The science of winning these violent storms is demonstrated by the techniques employed by a commander and his forces to threaten or destroy an enemy's critical tactical vulnerability. Such techniques include types of movement and attacks, formations, fire orders, etc. The art of winning battles, as discussed in Chapter IV, is reflected in a commander's unique combination of techniques to open a clear and unobstructed path to the enemy's vulnerability. Specifically developed for the time, place, and enemy encountered in the swirling storm of battle, the combination

of techniques is called tactics. A commander's tactics are the expression of this creativity, originality, confidence, and boldness within the storm of battle [Ref. 55:p. 37].

Critical vulnerabilities at the tactical level of war are more clear-cut than those at the strategic level. They are often physical targets: enemy centers of gravity, exposed flanks, chokepoints along an enemy supply line, an air defense belt [Ref. 37:p. 36]. They are what Jomini and Clausewitz referred to as decisive points, the destruction or seizure of which leads to a decision in battle [Ref. 52:p. 51]. Just because tactical vulnerabilities are easier to recognize, however, does not mean they are any less easy to discern or attack. Tactical commanders ply their trade deep in the storm of battle, where the level of disorder is highest. Location of weaknesses is difficult, their discovery fleeting. Success at the tactical level of war falls to those who can most quickly locate and attack these fleeting glimpses of critical vulnerabilities.

It is now easier to understand the "middle level" of command in war. Operational commanders link the efforts of the tactical commanders to the objectives of the theater CINC's, and indirectly to the overall strategic goal. Operational commanders decide both when and where to fight battles, and when and where to refuse battles, on a strategic basis. Their decisions are guided by the desire to "conserve ammunition," to achieve operational goals with the fewest

battles [Ref. 56:p. 45]. The operational level of command seeks to identify an enemy's critical operational vulnerability, to create a center of gravity at or near this key weakness, and to destroy or threaten the vulnerability so that the enemy quits the fight [Ref. 52:p. 57]. As the name of this level of war implies, the shaping of the local combat climate to either precipitate or threaten storms of battle is the realm of military operations:

> In war conducted by military forces the act of battle is a phase limited in time...The forces to be engaged must first be brought within range of each other and naturally each side will try to go into battle in conditions most favorable to itself. The sum total of the dispositions and maneuvers which go to make up this process is known as "operations." [Ref. 57:p. 59]

It is also easy to envision tactical operations -- the creation of tactical centers of gravity to attack decisive points found within a storm of battle. To prevent confusion, operations conducted at the operational level of war are called campaigns. Campaigns cover much broader geographical areas and much longer time-spans than do tactical operations [Ref. 58:p. 63]. Operational commanders are thus seen to practice the art and science of winning campaigns.

When all theater campaigns are viewed as a whole, the broad patterns that they reveal indicate the strategic CINC's overall strategy to unmask and destroy the enemy's strategic vulnerability. Just as this key vulnerability guides the actions of theater CINC's, so too do the CINCs' specific campaign plans guide the actions of the tactical commanders.

The result is a link that fuses the varying interpretations of vulnerabilities at the different levels of command, providing a seamless connection between war's highest policy aims and the physical actions of the gunfighters.

Tactical actions that in and of themselves have direct operational or strategic significance are called special operations [Ref. 56:p. 45]. **Special operation Commanders** usually lead small, highly-trained units on selective, dangerous missions against strategic or operational targets of opportunity. They typically deal in extremes: for some missions they have weeks, even months to prepare; other targets are fleeting, demanding immediate response. In either case, special operations are the "wild cards" used by the strategic warfighting and operational commanders to win high stake gambles within the climate of combat.

Table 1 shows some of the organizational relationships among the different levels of war. A cautionary note, however, is in order. The table is not meant to equate specific units with operations at a specific level of war. It is intended only to help visualize the three levels of war using representative field formations. As the definition of special operations makes plain, a tactical unit may be used to gain operational, or even strategic, results. Any mechanistic tendency to associate units with a level of war should be resisted [Ref. 58:p. 64].

TABLE 1
THE LEVELS OF COMMAND/WAR
[from Ref. 58:p. 64]

LEVEL	AREA ORGANIZATION	FORMATIONS
Strategic	Theater of War	Theater Component Commands Theater Army
Operational	Theater of Operations	Army Group Field Army Fleet Joint Task Force Task Force MEF (USMC) Corps
Tactical	Area of Operations	Division MEB (USMC) Brigade (Army) Task Unit MEU (USMC) Task Element

4. Forms of Warfare

Regardless of the level of war, combat comes in two basic forms: the **offense** and the **defense**. Offensive combat is the combat of imposition: its goal is to impose a decision on the enemy. The offense aims either to attack the enemy's critical vulnerability directly, or to attack lesser vulnerabilities until a path is discovered to the key enemy weakness. The initiative lies with the offense since the attacker precipitates the storm of battle: he picks the time,

place, and method to exploit his enemy's vulnerabilities. The offense is therefore the preferred form of combat to seek a decision in war [Ref. 37:p. 24].

Defensive combat is the combat of resistance: its goal is to resist an enemy's attempt to impose his will. The defense aims first to protect a friendly critical vulnerability from attack. Although the defense concedes the initiative to the enemy because it can only predict the time, place, and intensity of the coming storm, it is marked by positions or methods that seek to: limit the enemy's ability to select the place and type of attack; blunt the effects of the storm's first blow; magnify the effects of friendly weapons and advantages; and offer many blind paths that lead away from friendly vulnerabilities. In essence, a defense tries to turn the effects of the storm's disorder against the enemy. In this way, while the initiative lies with the enemy, so too does the likelihood that he will expose his own weaknesses before he can uncover those of the defense. Like the dealer who stands on 17, the defender offers the attacker the chance to "bust" the attack. The defense is the inherently stronger form of combat, and is especially appropriate for a weaker opponent [Ref. 37:p. 25].

Despite their differences, there are similarities and overlap between the theoretical extremes of these two forms of combat. If a goal of the defense is to entice the attacker to expose his weaknesses before he uncovers the defender's,

this implies that the defense is prepared to strike at these vulnerabilities. Indeed, an important, even decisive, element of the defense is found in the counterattack, making offensive action an integral component of the defense. Likewise, if the offense exposes a weakness before the defender's critical vulnerability is found, the attacker is often compelled to assume a temporary defense to protect it; this makes defensive action an integral part of the offense. In the practical application of armed force, there is often no clear-cut dividing line between offensive and defensive action [Ref. 37:pp. 25-26].

Although the line between the offense and defense is sometimes difficult to discern, it is marked by a concept called the culminating point. No offensive can sustain itself indefinitely. Over time, the inescapable effects of disorder combine to rob the offensive storm of its strength and fury. Moreover, the longer the attack lasts, the higher the probability that friendly vulnerabilities will be exposed to the defense. The culminating point is that point where it is either physically impossible or imprudent to continue the attack; the point where the attack is most vulnerable to an enemy counterthrust. It is at this point in time and space where the offense temporarily assumes the defense [Ref. 37:p. 26].

Despite their practical similarities and the difficulty in identifying the culminating point, conceptually

the two forms of combat are clearly divided by their initial intent. The offense seeks first to force a decision; a commander risks exposing his own weaknesses in order to allow him to actively seek out and attack his enemy's critical vulnerability at a time and place of his own choosing. In other words, the offense seeks to ride the wind, shaping the storm of battle in such a way that its full violence and fury is directed toward the defense. The defense seeks first to prevent a decision and only second to lay the groundwork to impose one. It seeks to blunt the force of a battlestorm before it can threaten a friendly vulnerability, and in the process both to exhaust the attacker and to lay him open for a decisive riposte.

5. Styles of Warfare

Good armies are those that can shape the climate of combat and threaten or precipitate battlestorms on terms favorable to themselves, and then direct the storms' fury to impose decisions upon their enemies. The terms **attrition** and **maneuver** warfare represent the theoretical extremes of the way armies attempt to modify war's unpredictable and disorderly environment to gain a decisive warfighting advantage[3] These two styles of warfare perceive and attack enemies' critical vulnerabilities in fundamentally different ways. Again, a

[3]As such, maneuver and attrition represent alternative environmental adaptation strategies for any warfighting architecture.

gambling analogy helps to characterize their differences.

The attrition style of war seeks only to take an enemy's pile of chips -- to "bust" the enemy commander. The enemy's critical vulnerability is always seen as his army and its material support. Attrition is simple to play. A commander plays every hand to win, and seeks a cumulative reduction in the enemy's ability to make a meaningful bet. The betting style is also easy to master. Because the end result of each hand is generally proportional to the size of the opposing bets, an attritionist raises the ante whenever and wherever possible. The larger the bets, the greater the "pot," and the higher the possibility of seriously depleting the enemy's playing reserves with a winning hand. Accordingly, play is generally more centralized; there are fewer players responsible for laying bets. Bluff and small bets are used only to protect a bad hand to minimize losses on a particular draw, not to influence an enemy's confidence. Because of the element of chance, losses are expected. However, the attrition style of play seeks to minimize chance's impact on the gamble's final outcome. This is done by using large initial stakes, and relying on the strategic and theater CINC's to make up losses incurred during play. Indeed, this is the very essence of attrition warfare: an inelegant and methodical grinding down of the enemy's stake until he is literally incapable of further play.

In contrast, "pure" maneuver warfare aims first to make the enemy "fold," and only second to make him "bust." Attrition occurs during play, but it is designed to influence the enemy's playing strategy and weaken his confidence and psychological strength, not to take his entire stake. A critical vulnerability is any weakness that will eat away at the opposing commander's will to continue the gamble. The style emphasizes the importance of identifying this vulnerability, and plays only those hands that seem most likely to unmask or attack it. Maneuver is characterized by decentralized play, it seeks to pit an enemy player against several friendly players who coordinate their playing strategy. The friendly player with the most promising cards is always the one left betting at the deciding point in the hand -- he is the gamble's "main effort."[4] The betting of supporting players and the timing of their withdrawal from the hand seek to confuse an rattle the opposing player -- especially to get him to overcommit to a weak hand. Bluffs are an integral part of the playing strategy, aimed at getting the enemy to forfeit his bet without playing out the hand. Chance and disorder ensure that the best friendly hand will

[4]Focus of effort(s) and main effort are key terms in maneuver warfare. The critical vulnerability is the focus of effort of multiple attacks. The most successful of the multiple attacks becomes the main effort. Note that this implies the main effort can shift as circumstances dictate. Maneuver commanders always support the main effort with the majority of resources [Ref. 59:p. 32].

not always survive the storm of battle. However, maneuver warfare seeks to enlist the aid of chance rather than to limit its effects. Sooner or later, chances are that one of the friendly players will get a hand strong enough to seriously test the enemy. Maneuver attempts to quickly identify this hand, and through coordinated play strengthen it as much as possible to increase the chance of its winning -- to make it the gamble's main effort. Until a strong hand develops, a maneuver commander is content to repeatedly fold, denying the enemy any opportunity to exploit a strong hand. In other words, the essence of the maneuver style is to continually pit strength against weakness, thereby frustrating an opponent's playing strategy.

Although these two styles of warfare are easily distinguishable in theory, like offense and defensive combat, they are less clearly defined in practice. Styles of warfare are really a combination of command style and tactical style [Ref. 48]. Command style refers to the emphasis in warfighting approach -- either attrition or maneuver -- at the operational and strategic levels of war. Tactical style includes the tactical level of command as well as the techniques employed by forces in physical contact with the enemy. Attempts to shape the combat environment often involve combining maneuver at the operational level and attrition at the tactical level of war or vice versa; the two seemingly opposing styles can coexist. Table 2 is a simple matrix to

help visualize the interplay of attrition and maneuver strategies between the different levels of war.

TABLE 2
THE STYLE OF WARFARE MATRIX

		TACTICAL STYLE ATTRITION	TACTICAL STYLE MANEUVER
COMMAND STYLE	ATTRITION	Union; Civil War Allies; WWI Pre-modern naval warfare	Battle of the Saints Soviet Navy Submarine Campaigns
	MANEUVER	Emperor Napoleon Patton's Third Army Soviet Army	Genghis Khan, Mongols Germans, WWII Israelis, 1967

There are many examples of an attrition-attrition style of war. This style is along the lines of warfare practices by the Union during the Civil War, by the Allies along the Western Front in World War I, or (for the most part) by opposing navies up until the invention of the airplane and submarine. The command style is focused on logistics -- mustering superior resources (bets) at the proper time and place. The tactical style treats the enemy as an inventory of targets, to be destroyed by sheer firepower and weight of metal [Ref. 60:p. 86]. Movement is used primarily to increase the effects of friendly weapons on the enemy. The overall style is to pit strength against strength. While brutally effective, attrition storms are among the most violent in war,

and take an enormous toll in both men and material. Willingness to embrace this style implies a net superiority in available resources over the course of a war.

The maneuver-maneuver style is best characterized by Genghis Khan and the Mongols, the Israelis during the 1967 War and the latter part of the 1973 War, and the Germans during World War II (at least at the operational level and below). The command style focuses on "relational" action -- action guided by a close study of the enemy and his way of doing things. The purpose is to muster overwhelming strength against an enemy's operational vulnerability, even though the enemy may have superior overall strength [Ref. 60:p. 86]. The tactical style is decentralized; many small units, guided in their actions by the tactical commander's overall plan, use relational movement to find or create enemy vulnerabilities. The tactical commander then tries to exploit these weaknesses to shape and win the battle. The German term for this unique tactical style is <u>aufstragtaktik</u> [Ref. 61:p. 29]. As this style focuses less on destroying the enemy's forces and more on crushing the enemy's will to resist, it is especially attractive to an army facing an opponent who has superior strategic strength and reserves.

The combination of a maneuver command style and an attrition tactical style is the style of warfare perfected by the Emperor Napoleon, and later used with great success by Patton and his Third Army and the Soviet Army in World War

II. This command style is characterized by violent penetration battles, using attrition tactics, followed by large-scale encirclements. It is especially suited for mass conscripted armies that do not possess the training to practice aufstragtaktik, but who seek the operational flexibility of maneuver. This is the style Americans would face today in a fight against a Soviet-trained or led opponent. Maneuver-attrition style may also be dictated by other factors, such as the nature of the theater of operations. The Pacific Theater in World War II led to an amphibious campaign that combined strategic/operational maneuver with attrition battles [Ref. 37:p. 28].

The attrition-maneuver style of warfare is uniquely naval in character. Naval warfare is a force-on-force process that tends toward the simultaneous attrition of both sides at all levels of war [Ref. 62:p. 146]. With the advent of airplane and the submarine, however, naval maneuver at the tactical level became commonplace. Submarine campaigns are examples of this style of warfare, and the Soviet Navy practices this warfighting style today. But attrition-maneuver warfare was not "invented" along with the airplane and the submarine. George Bridges Rodney and his British fleet defeated Comte de Grasse and his French fleet at the 1782 Battle of the Saints using this style, and Admiral Nelson later perfected it to high levels [Ref. 63:p. 56-61].

Inventive naval commanders have often resorted to tactical maneuver to achieve naval operational attrition.

Styles of warfare are thus less clear-cut than a simple comparison between "pure" attrition and "pure" maneuver would suggest. As war is characterized by an infinitely variable environment, any strategy that seeks to shape its climate must also be infinitely variable. Attrition and maneuver merely mark the ends of a continuum of options available to help create a wartime or combat advantage, and to exploit an enemy's perceived critical vulnerability. While an army can emphasize one approach over the other, it must be prepared to use both styles in combination to flourish in war.

D. DESTROYING A CRITICAL VULNERABILITY: APPLYING COMBAT POWER

1. Combat Power Defined

Physical damage in battle results from the strike of a "bullet," aimed and fired from a commander's weapon. The bullet represents some portion of the commander's available combat strength, delivered in some way to impel force on the enemy. Obviously, to hurt an enemy, he must first be hit. This is not an easy task, even after a vulnerability has been identified. Chance and disorder make "aiming in" a difficult proposition. And friction and chance ensure that bullets seldom hit the commander's point of aim. But when a bullet does strike home, the damage it inflicts is measured by its combat power -- the total destructive force brought to bear

on an enemy target at given time and place [Ref. 37:p. 30].

Combat "power" is a uniquely appropriate term borrowed from physics. At the risk of trying to over-rationalize war, it is helpful to fully understand the scientific meaning of power. Whenever a body exerts a force (measured by the product of its mass and acceleration) on an object and causes its displacement, work is done on that object. Work is defined as the product of the body's (bullet's) force, the distance the object (enemy) is moved, and the angle of impact between the bullet's path and the enemy's displacement. Power is nothing more than work divided by a time interval. In other words, if the bullet causes no enemy displacement, no work is done, and no appreciable combat power is applied against the enemy.

By measuring the total destructive force on a target in terms of power, damage to the enemy is linked back to the two complementary goals of every gunfight: to conserve ammunition and to end the fight as quickly as possible. If a friendly bullet is fired at a target with no measurable power, then the bullet either missed or it did not have enough force to hurt the enemy or overcome his defenses. Alternatively, the bullet did some local damage but not enough to move the enemy. In this case, the point of impact was neither a decisive point nor a critical vulnerability; the lack of damage was caused by poor target selection. In either

case, the bullet was wasted, and the commander's available combat strength is dissipated toward no useful combat purpose.

Setting aside the problem of target selection, which was covered in the previous section, and the effects of chance, which are unpredictable, one is left with the following question: what can be done to increase the damage caused by a commander's bullet? Restated, how can a commander deliver maximum combat power against the enemy?

2. The Essential Components: Concentration and Speed

The greater a bullet's mass, the greater its force, and the greater the potential work done on the enemy. Therefore, a logical step toward maximizing combat power is to increase the size of the bullet -- the amount of friendly force -- which strikes the enemy at a specific time and place. But combat power also depends on the distance the enemy is displaced by the strike of the bullet, which is often directly related to the relative masses of friendly and enemy force at the bullet's point of impact. The larger the ratio of friendly to enemy force there, the greater the enemy's potential displacement. Concentration, not mass, is therefore the first true step toward generating effective combat power.

Concentration is a central tenet of warfare. The ability to create local superiority at the bullet's point of impact is the "aim" of all commanders: "In war, numbers alone confer no advantage...It is sufficient to estimate the enemy situation correctly and to concentrate your strength to

capture him" [Ref. 41:p. 122]. Concentration of force applies to all available resources, and implies a willingness to economize elsewhere to achieve it. This often means leaving paths to friendly vulnerabilities less protected than desired, and accepting the associated risk that they will be discovered and attacked [Ref. 37:p. 31].

Recall that battlestorms have grown in scope as the result of unit dispersion made necessary by the range and lethality of modern weapons. Therefore, to concentrate friendly units entails risks of its own, and these risks must be moderated by concentrating in time as well as space. Knowing when to concentrate is an important trait of a good commander. As Sun Tzu said, "The strike of a hawk...breaks the back of its prey for the reason it waits for the right moment to strike. Its movement is regulated" [Ref. 41:p. 92]. Like the gunfighter who is always on the move, stopping to fire only when the enemy presents a vulnerable target, a commander disperses, concentrates, and redisperses his forces to regulate the timing and placement of his "shots" -- potential combat power.

The science and art of regulating the application of combat power depend on unique types of combat speed. The science of regulating potential combat power is based on velocity. Combat velocity -- the distance that a unit can cover over a given amount of time -- is a measure of a unit's ability to move fast [Ref. 37:p. 32]. Both to quickly

concentrate widely dispersed forces at the decisive place and time, and to redisperse them after an attack, individual units must possess high combat velocities.

The second type of combat speed is tempo. Tempo is speed over time -- the ability of a force to "operate" quickly [Ref. 37:p. 32]. Tempo reflects the art of regulating potential combat power, in that it includes both the commander's ability to choose the precise placement and timing of an attack, and the ability of his forces to hit the point of decision at the right time. In other words, tempo is a direct measure of an army's decision-action cycle.

The combination of high combat velocities and high tempo helps a commander shape the combat climate in his favor. High combat speeds are the second key component necessary for generating high potential combat power. Remember that combat power is directly related to the amount of armed force that can be exerted against an enemy over a given length of time. The higher the combat speeds, the shorter the time interval during which force can be applied against an enemy, and the greater the potential combat power. Of course, if the enemy possesses equal or greater combat speeds, he can more quickly mass at a point of decision and effectively blunt the amount of combat power that can be applied against him. Therefore, like relative mass (concentration), the second key contributor to potential combat power is higher relative combat speeds.

The combination of concentration and high relative combat speeds is momentum, another physics term uniquely suited to warfighting. In the absence of opposing force, the momentum of a friendly unit will remain relatively constant. "Other forces" in combat are general friction and any opposing force brought to bear by the enemy. If the effects of friction are minimized and the enemy cannot or is prevented from bringing opposing force to bear, momentum propels a commander's forces deep into the enemy's defenses. The "shock" and "penetrating" effect of momentum greatly enhances an attack's final combat power [Ref. 37:p. 32].

3. Enhancing Combat Power: Surprise and Deception

One way to prevent an enemy from effectively countering friendly momentum is to surprise him. Achieving surprise is a key goal in war. It entails hitting an enemy at a time, place, or manner for which he is unprepared, causing disorientation in the mind of the enemy commander as he perceives a major, rapid, and dangerous change to the combat environment. The typical result is a psychological paralysis that prevents a timely, organized, or coherent enemy reaction to the change. The paralysis may only be temporary, or may result in the total collapse of an opponent's ability to resist. In any event, the victim of surprise is at a distinct disadvantage in offering an effective counter to the application of combat force against him.

In modern military jargon, surprise is a "force multiplier," psychologically magnifying the amount of combat power delivered against an enemy. Baron Whaley, in a 1976 (unpublished) manuscript entitled Stratagem: Deception and Surprise in Warfare, tried to quantify the impact that surprise exerts in war [Ref. 64]. Tables 3 and 4 summarize his examination of the effects of surprise in 168 battles fought in 16 wars between 1914 and 1968. Several key points stand out.

TABLE 3
FORCE USED TO GAIN OBJECTIVES AFTER WORLD WAR I
[from Ref. 64:p. 193]

	SURPRISE		NO SURPRISE	
ACHIEVEMENT	NO.	FORCE RATIO	NO.	FORCE RATIO
Victory	18	1.2:1	1	2.5:1
About as planned	28	1.1:1	4	1.4:1
Below expectations	17	1.4:1	9	1.4:1
Defeat	4	1.0:1	20	.9:1
TOTAL CASES	67		34	

TABLE 4
EFFECT OF SURPRISE ON CASUALTIES IN 90% OF CASES 1914-1967
[from Ref. 64:p. 193]

	NO. CASES	AVG. CASUALTY RATIO
Surprise	79	1:5.3
No surprise	45	1:1.1
TOTAL	122	

First, when surprise is achieved, 69 per cent of military actions result in outright victory or substantial success. The success rate falls to 15 per cent when and where surprise is not achieved. Second, surprise seems to quintuple the relative casualty ratio between the victim and benefactor of surprise. Third, to achieve victory without surprise, concentration is an essential requirement; a 2.5:1 superiority of forces is needed at the point of decision. The comparable ratio to achieve victory with surprise is less than half that. It seems clear that surprise is indeed a multiplier of combat power, allowing a commander to use his men more sparingly and with better results.

There are four general ways to achieve surprise in war. The first is through sheer chance. In the disorderly storm of battle, random collisions are commonplace. Depending on the vigilance of the colliding forces, either one or both sides may be surprised. In the first case, the advantage of

surprise falls to the commander and force better able to shake off the resulting shock and dictate subsequent actions. In the second, the ability of the unaffected combatant to exploit the enemy's disorientation before he can recover will determine the final impact that surprise plays in the encounter. Note that in both cases, higher relative tempo is the critical factor which determines which force will overcome or exploit the effects of random surprise.

Because of the uncertainties of chance, most commanders actively try to **create** the conditions favorable for surprise. One way to do this is through security -- the passive attempt to conceal friendly intentions or preparations from the enemy. Unfortunately, even the tightest security measures help achieve surprise only against the most preoccupied or incompetent enemy. Whaley determined that out of 116 selected examples of strategic and tactical surprise, only 11 could be "exclusively or even mainly attributed to security." The lesson is that specific warning signals almost always pass through a security screen to be received by the intended victim [Ref. 64:pp. 1-2]. For a commander intent on achieving surprise, relying on security seems little better then pure chance.

A more likely means of achieving surprise is to constantly operate at higher combat tempos -- to use speed as a weapon of surprise. While higher combat speeds allow a commander to exploit the random surprises that inevitably

occur in the climate of combat, higher speeds can also be used to create the conditions for surprise. As Sun Tzu said, "What is the greatest importance in war is extraordinary speed;...when the thunderclap comes, there is no time (for the enemy) to cover his ears" [Ref. 41:p. 70]. Higher relative combat speeds creates ambiguity and confusion in the mind of the enemy commander, as he is unable to keep up with unfolding events. When the next "thunderclap" arrives, the result may be an overload in the enemy's ability to respond or adapt, and surprise is complete. Frequent envelopments and high prisoner count are symptoms of this type of surprise [Ref. 64:pp. 99-100].

The fourth way to achieve surprise in war is through deception, the deliberate attack on the mind of an enemy commander to mislead him or to cause him to do something counter to his interests [Ref. 65:p. 1-1]. However, the effects of deception are so different and powerful that it should be viewed as a separate and distinct multiplier of combat power. Consider the data in Table 5, again drawn from Whaley's work on surprise and deception. The average casualty ratio for surprise through deception is over three times that of surprise without deception, suggesting that a fundamentally different psychological effect is at work. Whaley deduced that while surprise is often the direct result of a war's uncertainties, deception makes a commander quite certain, very decisive, and **wrong** [Ref. 64:p. 135].

TABLE 5
SURPRISE AND DECEPTION
[from Ref. 64:p. 195]

	No. Cases	Avg. Casualty Ratio
Surprise with Deception	57	1:6.3
Surprise without Deception	20	1:2.0
No surpirse with Deception	5	1:1.3
No Surprise without Deception	40	1:1.1
TOTAL	122	

A successful deception either deepens or prolongs the enemy's psychological paralysis after being surprised, or prevents him from taking effective counteractions to respond to surprise. In the first case, the onset of disorientation caused by deception occurs much later than that caused by "normal" surprise. This delay is due to the fact that changes in the environment precipitated by friendly forces do not initially shake the enemy commander's perception of friendly intentions. Friendly moves are themselves seen as a feint! By the time the enemy's perceptions do change, the environment is so radically altered that his resulting disorientation is over three times as severe as a case involving surprise. In the second case, deception seeks to both facilitate friendly concentration and to seriously delay enemy attempts to apply effective counterforce at the point of attack:

> If I am able to determine the enemy's dispositions while at the same time I conceal my own, I can concentrate and he must divide. And if I concentrate while he divides, I can use my entire strength against a fraction of his...and those I deal with will be in dire straights. [Ref. 41:p. 98]

Surprise through deception is thus seen to be related to, but separate from, other types of surprise. Surprise caused by chance, security, or higher relative tempos all result in immediate disorientation as the victim perceives a rapid and dangerous change in the environment. Deception, on the other hand, results in a much delayed disorientation, as the most important and dangerous change in the environment is either missed or misunderstood. Disorientation, when it does come, is thus far more severe. When successful, deception is the most powerful tool available to multiply the effects of combat power.

E. ENDGAME

As discussed in Chapter IV, the aim of war is to impose one's will on a hostile and resisting opponent. Recall that there are two ways to achieve this aim. The first is to physically take the opponent's stake -- to destroy his fighting forces or the means critical to their support. The second is to psychologically take the opponent's stake -- by destroying his will to resist. In either case, war is ultimately decided by the relative abilities of the opposing commanders to identify and target their enemy's critical vulnerabilities, and the relative abilities of their forces to apply superior combat power against them. Chance and luck do, of course, play a big part in both of these abilities. But war's final decision is based on the results of, and not

the intent of, these two key factors.

Decision by a "Caesar," **action** by his "legions." This in a nutshell is the process that drives the engine of war. Regardless of war's policy motives, the level of command involved, the style of warfare a commander prefers, or the form of combat a commander pursues, war is the cumulative result of countless decisions and actions made to quickly locate and destroy an enemy's critical vulnerabilities through the superior application of combat power. To do this consistently better than one's opponent demands that the effectiveness of one's decision-action cycle be superior to the enemy's.

Chapter IV proposed a view of war that turns heavily on the attributes of the commander. This chapter expands that view in the practical realm of warfighting to include the commander's weapon -- his armies. The next step is to develop a model for the fundamental combat action process -- the decision-action cycle. Once this combat action model is developed, the framework for a relevant National Space Warfighting Architecture will be complete.

VI. THE COMBAT ACTION PROCESS: A MODEL

A. INTRODUCTION

The last thing that must be discussed before the framework for a National Space Warfighting Architecture can be built is the combat action process itself. While the previous chapter attempts to delineate the fundamental importance that this process plays in war's outcome, it is important that its components be fully defined and understood to gain an appreciation of the NSWA's individual and organizational decision-making structure. The purpose of this chapter is therefore to develop a conceptual model that describes the inner workings of the combat action process. Once again, the intent is to present a model that is applicable to all services, in all types of conflict, at all levels of command, regardless of preferred style of war or form of combat.

B. DEFINING FORCE COMBAT EFFECTIVENESS

What makes an effective fighting force? The pat answer is commanders who make consistently good decisions and issue clear and appropriate orders, and whose fighting men then reliably and proficiently carry them out. But what are "good" decisions and orders? What is "proficient" performance? Before **force** combat effectiveness can be discussed, one must

first define measures of combat performance and combat effectiveness.

Combat performance can generally be measured by an army's ability to apply armed force against its enemy. The higher the level of force applied, the higher the level of combat performance. Remember, however, that armed force may be expended toward no useful purpose in war unless that force is converted into combat power. In other words, any army's actions must be relevant as well as proficient; the army must direct armed force against its enemy's critical vulnerabilities. Relevancy of an army's overall actions is judged primarily by the political aims of the war itself, while at the individual levels of war it is gauged by a commander's ability to discern his opponent's key weakness. Combat effectiveness is therefore a combination of an army's performance and the relevance of its actions; it is marked by a proficient army, applying appropriate levels of combat power, against critical vulnerabilities, in pursuit of identifiable and appropriate political aims.

Armed with these conceptual measures of combat performance and effectiveness, it is now possible to consider a definition for force combat effectiveness. Note that an army's actions can be both relevant and proficient -- its commanders can make good decisions and orders and its fighting men can proficiently carry them out -- and its overall force effectiveness can still be low. If an enemy is consistently

better able to locate and destroy friendly critical vulnerabilities, then the best laid and most relevant plans, coupled with an army's best performance, will more often than not come up short over the course of a war. Force combat effectiveness is therefore a measure of **relative** wartime performance and effectiveness.

In broad terms, an effective fighting force is one that is better able to shape the climate of combat and precipitate battlestorms on terms favorable to itself, and then operate within the storms' disorderly confines to achieve consistently favorable combat results. This view of force effectiveness implies a consistent relative superiority in finding and destroying critical vulnerabilities at all levels of command. It also helps one understand the remarkable successes that certain leaders and armies have enjoyed against enemies who are every bit as well equipped and motivated. For example:

- Alexander's ability to sense weakness and fear at a certain point in his opponent's lines, and his army's ability to hit the point with a rapid, well-aimed and regulated thrust.

- Napoleon's ability to see the seams between his opponent's formations, and his army's ability to quickly hit these seams to divide and shatter the enemy's cohesiveness.

- The Israelis' ability to discern their opponents' critical operational vulnerabilities, and their army's ability to exploit these vulnerabilities to create a decisive advantage in war [Ref. 66:p. vii].

In each case, the key to combat success is found in superior force combat effectiveness, which is in turn measured

by: a commander's ability to sense his enemy's key weakness and to devise a workable plan to attack or exploit it; and his force's ability to carry out the plan and to apply combat power against the weakness. "Decision-action" is therefore, an incomplete description of the combat action process. A more accurate one is "sense-decision-action." An effective fighting force is one with relatively superior sense-decision-action processes at all levels of command across the entire spectrum of conflict.

C. CHOOSING A FOCUS: DEBATING THE CHOICES

1. Command and Control or Command and Action?

Recognizing the importance that the sense-decision-action process plays in determining war's final outcome, one is faced with an immediate dilemma when developing a model to describe and understand it: what should be the model's focus? There seems to be two basic approaches. The first, the **command and control** approach, focuses primarily on the commander's role in war. The second, the **command and action** approach, focuses on the role of the fighting force as a whole. The choice is critical, as it will in large part determine the effectiveness of any model that hopes to describe the complete combat action process.

2. Command and Control

Consider carefully Martin Van Crevald's description of the command process in his book Command in War:

> There is, in the first place, the gathering of information on the state of one's own forces...as well as the enemy and on such external factors as the weather and the terrain...Means must be found to store, retrieve, filter, classify, distribute and display it. On the basis of the information thus processed an estimate of the situation must be found. Objectives must be laid down and alternative methods for attaining them worked out. A decision must be made. Detailed planning must be gotten under way. Orders must be drafted and transmitted...Execution must be monitored by means of a feedback system, at which point the process repeats itself. [Ref. 45:p. 7]

In other words, Van Crevald sees the command process consisting of some nine steps: gathering information; collating information; preparing an estimate of the situation; selecting objectives; developing alternatives, making a decision; preparing a plan; transmitting orders; and monitoring force execution. The subtle implication is that the command process is separate from the actions of a commander's forces; the two are linked, but conceptually divided processes. A repetitive command process allows a commander to adjust and control the (separate) action process(es) of his forces. Thus, the term command and control, which according the Joint Chiefs of Staff (JCS), is the "exercise of authority and direction by a properly designated commander" by "planning, directing, coordinating, and controlling forces and operations" [Ref. 67:p. 77]. In other words, both parts of command and control are focused on the combat leader: command decides what he wants to do in

combat, and control shapes and prods the actions of his forces to turn that want into reality [Ref. 68:p. 7].

Perhaps the first U.S. model to fully describe the command and control process was the one developed jointly in 1977 by Dr. Joel S. Lawson and Professor Paul Moose (see Figure 4). The Lawson model, as it is now called, uses five action verbs to describe its key steps [Ref. 62:p. 185-186]. These five steps generally mirror those outlined above by Van Crevald, with two small differences. First, several of Van Crevald's steps are combined into single steps in the Lawson model (see Figure 5). And second, whereas single iteration of Van Crevald's command and control process ends with task "monitor" before it begins to repeat itself, monitoring friendly actions is part of the first step of a subsequent iteration in the Lawson model.

Despite these minor differences, however, there is one key similarity between the two models: since their focus is clearly on the commander's personal wartime role, they describe only the first two steps of the sense-decision-action process. As a result, there is no clear feeling of the fundamental bond that links a commander and his forces as an **indivisible** fighting entity. Moreover, the processes are **one-sided** -- they fail to portray the enemy's competitive command and control process.

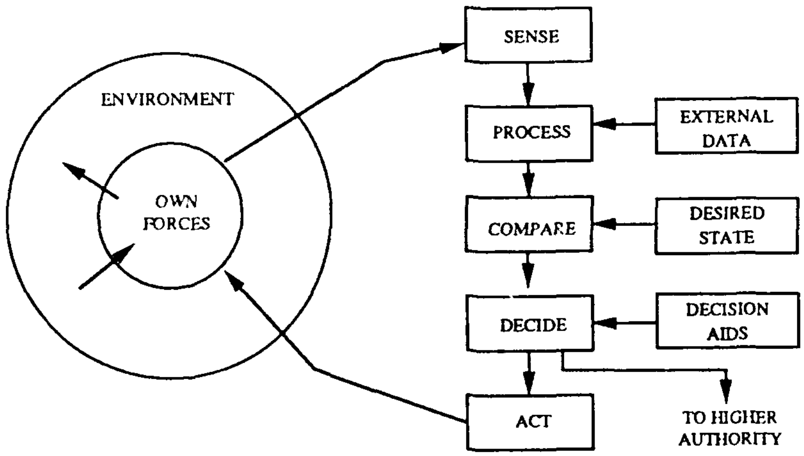

Figure 4. The Lawson C² Model

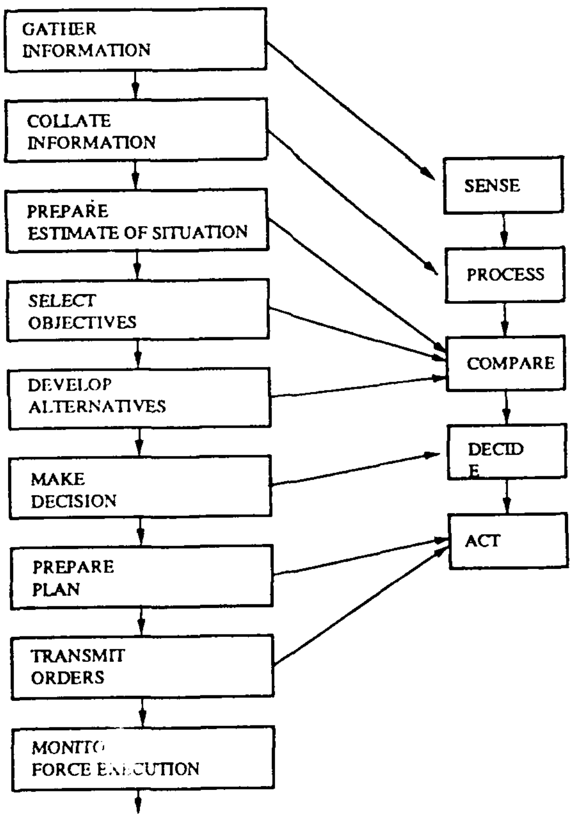

Figure 5. Comparing the Van Creveld and Lawson C² Models

Different, more recent command and control models continue this pattern (see Figure 6). The four models shown differ only in the way that their basic processes are partitioned, as indicated by the changes in the words that describe their respective steps [Ref. 70:p. 6]. Notice that the models that use verbs to describe their steps usually have more than those which use nouns or phrases, since nouns describe subprocesses that incorporate several smaller steps. Regardless of their length, however, all the models have similar endings: two of the processes end with the verb "direct," one with the noun "decision," and one with the phrase "response selection." All continue to focus on the friendly commander and the effect that he has on his own forces and the combat environment.

There are some signs of change. Dr. Lawson now believes that his model should accommodate the enemy control cycle, resu ng in the conceptual model shown in Figure 7 [Ref. 62:pp. 186-187]. While showing the competitive interplay between friendly and enemy C^2 processes is a step in the right direction, it cannot overcome a fundamental weakness of the command and control approach. By dividing the sense-decision-action process into two parts, and then focusing on only one of them, command and control models hinder a more complete view of combat. The problem, of course, is that these models were developed not to understand combat in its

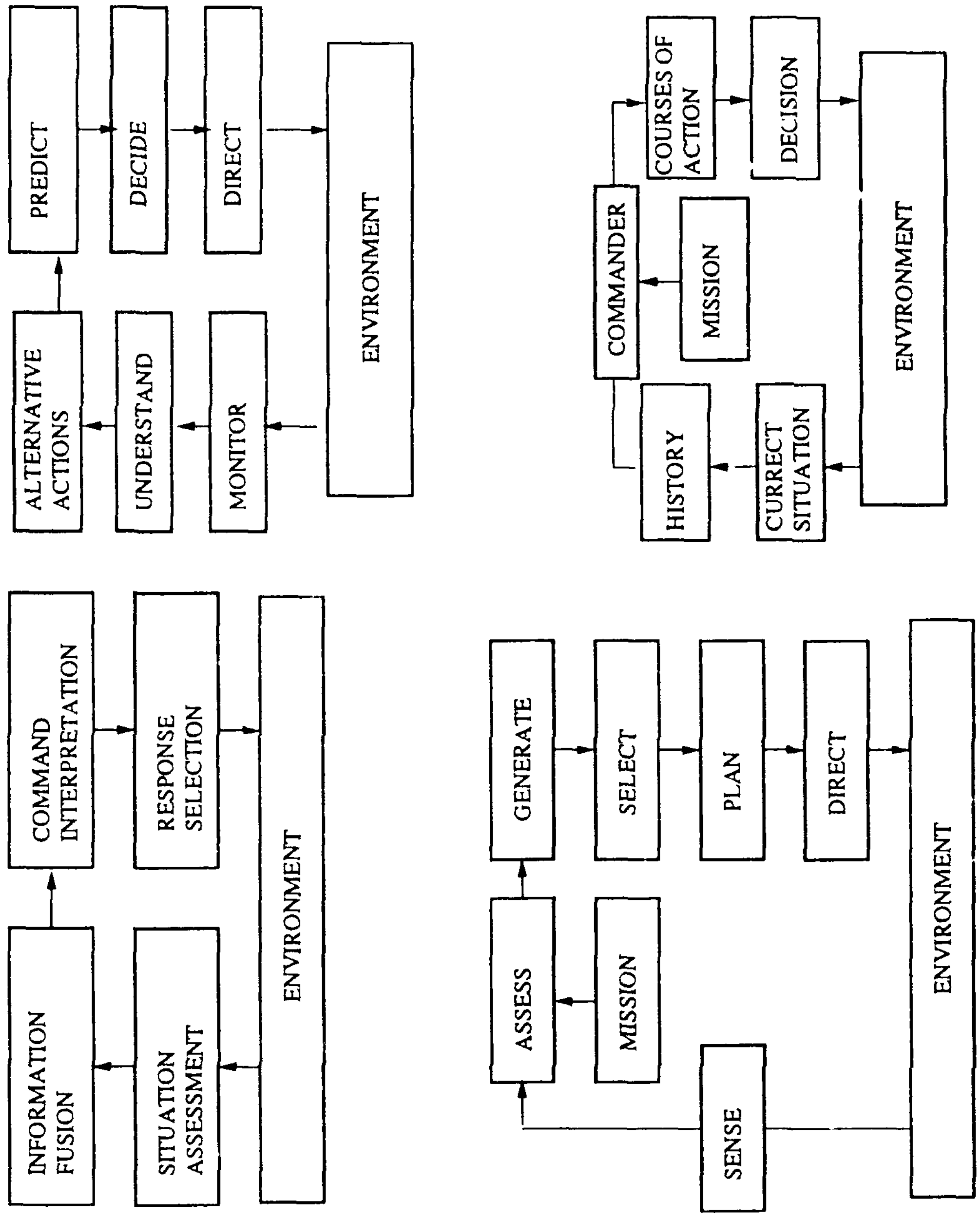

Figure 6. Selected C² Process Models

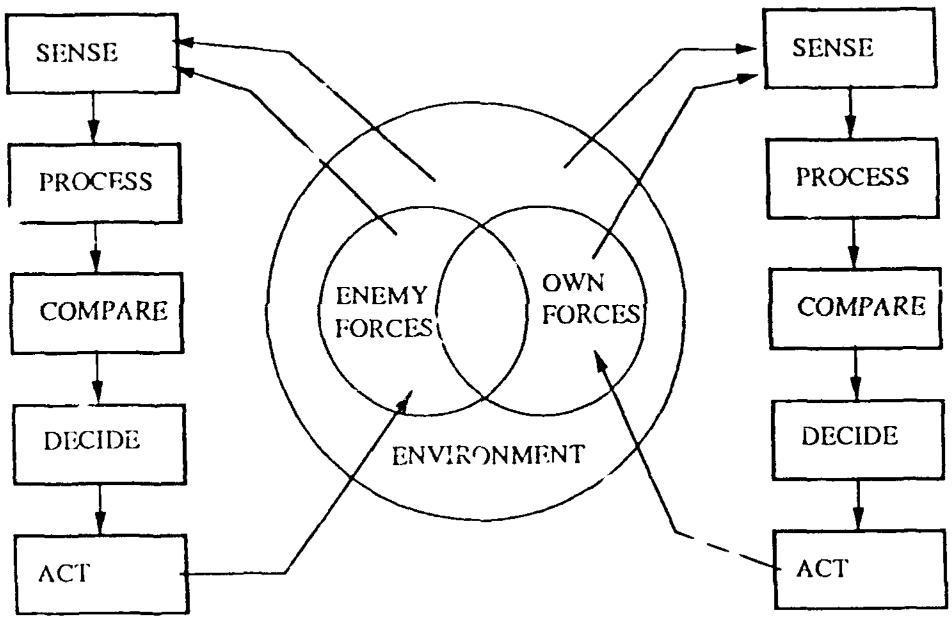

Figure 7. The Updated Lawson C^2 Model

more general sense, but to help quantify and evaluate C^2 "system" performance at specific levels of command. They therefore quite rightly focus on the commander's personal role in war and the technological aids to help him reach a decision and to subsequently control his focus. The models successfully convey the primary importance of the commander in war. They simply do not go far enough. The only way to capture a full understanding of war is to consider sense-decision-action as a conceptually indivisible combat process.

This is the thrust of the command and action approach. As its title implies, this approach also stresses the importance of the wartime role of the commander. However, it considers him to be only a part, albeit a key part, of a single, inseparable fighting entity. The tenuous link of "monitoring force execution" is not strong enough to describe the complex interactions that characterize the commander/unit wartime team. Both the commander and his forces are buffeted by the winds of disorder and the currents of chance, and both must adapt and act together to survive their fury and emerge victoriously from battle.

In the opinion of this author, the command and action approach is the correct one for a combat model that hopes to capture the ideas and concepts presented in this thesis. Two questions, therefore, come to mind. Have any command and action models been proposed? And if so, are they suitable for use within the framework of a NSWA?

2. An Interim Step: the "S-E-D-A" Cycle

The first apparent step to develop a command and action model was made in 1971 by Brigadier General F.P. Henderson, USMC (Ret). General Henderson proposed a sense-evaluate-decide-act (or S-E-D-A) cycle to describe "operational" processes in combat (not to be confused with the operational level of command). Notice that the cycle adds only one additional step -- evaluate -- to the previously developed sense-decision-action process. Note also that in contrast to most command and control models, the cycle ends with the word "act" instead of direct, response selection, or monitor. These two facts alone warrant a closer examination of the General's creation.

General Henderson feels the S-E-D-A cycle is the "essential antecedent of every tactical action, from the individual rifleman to the highest command echelon" [Ref. 71:p. 21]. The process is called "the most critical, frequent, and non-uniform sequence action in the (combat unit)." In fact, in the General's view, "the degree of excellence of this process has been the greatest single factor in success or failure in battle." Excellence is measured by the "speed and quality" of the process [Ref. 71:p. 37].

General Henderson is clearly aiming for more than the command and control approach with the S-E-D-A cycle, since the cycle applies to all fighting men, not just leaders. He plainly recognizes the competitive impact that the enemy's

process plays in battle, since in his view battlefield success falls to the side with the "superior" S-E-D-A cycle -- the one with the higher relative speed and quality. Moreover, he hints at the unified nature of the warfighting unit by pointing out that a sure path toward higher process speeds is to decentralize -- to distribute "operational" responsibilities vertically within a fighting force. In this way, no echelon of command is "overloaded" in combat [Ref. 71.p. 37]. This concept is developed further by his pointing out that the cycle is non-uniform, meaning that the length and character of the cycle are different at different levels of command. Finally, since the process is the "antecedent of every tactical action," General Henderson feels it to be applicable to both forms of combat (the offense and the defense) and in all tactical situations. Developed by a warfighter for the warfighter, the S-E-D-A cycle aims to describe the general nature of combat.

But a careful reading of the General's writings reveals that the S-E-D-A cycle is a closer relation to the command and control approach than it is to the command and action approach. Although the S-E-D-A cycle purportedly describes things to be done in combat by all Marines, in "every occupational specialty" [Ref. 72:p. 24], its emphasis remains squarely on the commander: "The sense-evaluate-decide-act process centers about the units commander at every tactical echelon. Ideally the process system should be fully

responsive in real time to his needs and desires." And the "act" in the commander's cycle refers not to the actions of his forces, but to his issuing of orders to those forces, and to his requests to higher and supporting units [Ref. 71:p. 37]. Like the command and control process, the S-E-D-A cycle is more an individual vice collective endeavor, with only an implied link between the actions of the commander and the actions of his forces.

The S-E-D-A cycle is therefore only a good first step toward a more complete combat action model. It is especially useful for identifying the additional steps necessary to reach that final model. Like the S-E-D-A cycle, the final model must emphasize the commander's importance in war. It must similarly include the idea of relative superiority -- force combat effectiveness -- by acknowledging the competitive nature of the friendly and enemy sense-decision-action processes. And it must continue to integrate the following key ideas: that the way to superior force combat effectiveness is through higher relative process speeds; that the process, although universally relevant, is non-uniform in length and character depending on the level of command and the tactical situation; and that the process is applicable to both offensive and defensive combat. However, the final model must include two more ideas before it completely describes the sense-decision-action process. First, it must describe the entire combat action process, showing the inseparable

relationship between the commander and his forces in war. And second, it must be compatible with both maneuver and attrition warfare. These seven ideas form the measures of effectiveness (MOE's) by which a combat action model must be judged.

3. Command and Action: the O-O-D-A Loop

In 1980, a retired Air Force Colonel, John R. Boyd, finished an extraordinary study entitled "Patterns of Conflict." The study had four goals: to make manifest the nature of moral-mental-physical conflict; to discern a pattern for successful operations; to help generalize tactics and strategy; and to find a basis for "grand strategy" [Ref. 73:p. 3]. Surprisingly, the point of departure for these ambitious goals was the air-to-air battles that occurred between American F-86 fighters and Chinese MiG-15 fighters in the skies over Korea. Although the Mig-15 had superior absolute performance characteristics (speed, rate of climb, etc.), the overall air-to-air kill ratio was over ten-to-one in favor of the F-86. "Patterns of Conflict" resulted in part from Colonel Boyd's curiosity about the reasons for the F-86's formidable combat prowess [Ref. 73:p. 5].

Colonel Boyd attributed the F-86's success to three key factors. First, the F-86's bubble canopy afforded an American pilot a clear and unobstructed view of the sky, while the MiG-15 cockpit severely restricted his opponent's view. Second, the superior experience and tactics of the American pilots

(many were World War II air combat veterans) seemed to allow them to more quickly "size up" a tactical situation and to decide what and how they wanted to do in a dogfight. Third, the F-86 was more responsive; the time between a pilot's decision to maneuver and the plane's response was much faster than the comparable time for the MiG-15 [Ref. 74].

The net result: American pilots were consistently able to **more quickly** observe the combat environment, adapt to each unique tactical situation, make a decision about how to maneuver against their enemy, and then translate that decision into a position of relative advantage. Or if Clausewitz had described it, American "commanders" could better penetrate the fog of war; had less uncertainty; had both personal courage and the courage to accept responsibility; had the creativity and means to exploit fleeting, unanticipated opportunities; and their forces faced less friction. They were then able to use these cumulative advantages to shape the climate of combat in their favor and more consistently and effectively attack enemy critical vulnerabilities. Note however, that it was the pilot/plane combat system, the combined strength of the commander and his "unit," that was decisive. One without the other could not explain the decisive success enjoyed by American air forces over Korea [Ref. 74].

Colonel Boyd logically postulated that any commander and fighting unit endowed with the conceptual advantages of the pilot/F-86 combat team would be as consistently successful

in the gamble of war. To assist in the in-depth research that followed, Boyd developed a model that captured these conceptual advantages and which could be used to critically study war from any level of command and in any combat situation.

So was born the Observation-Orientation-Decision-Action, or "O-O-D-A," loop. The O-O-D-A loop is a true command and action process; it describes the complete sense-decision-action cycle. In the process, it incorporates the strengths of both the command and control and S-E-D-A cycles. Its conceptual birth from one-on-one aerial combat makes clear that the process has meaning only in relation to an enemy's command and action cycle. The model effectively depicts the importance of the commander's wartime role. A key idea imbedded within the process is that the outcome of battle is often decided by higher relative process speeds. It is applicable to all levels of war, but is constructed in such a way that the process is seen to be nonuniform between the different levels of command. The process is also equally effective describing actions that take place in "blitz" (offensive) and "counterblitz" (defensive) operations [Ref. 73:pp. 64 and 124]. Based on the MOE's outlined in the previous section, if the O-O-D-A loop is relevant to both types of warfare, it would appear to be ideally suited as the basis for a universal combat action model.

Because Boyd's final conclusions from "Patterns of Conflict" are often used to support the concepts of maneuver warfare, the O-O-D-A model is often thought to describe a unique maneuver command and action process. For example, the idea of higher relative process speeds, an important concept in maneuver warfare, is totally absent from discussions about attrition warfare in <u>FMFM-1, Warfighting</u> [Ref. 37:pp. 28-29]. In fact, <u>FMFM-1</u> implies that attrition warfare has no need for a selective command and action process, as in attrition warfare, "any target is as good as any other as long as it contributes to the cumulative destruction of the enemy" [Ref. 37:p. 85].

These views are wrong. The ideas imbedded in the O-O-D-A model have strong ties to attrition warfare. First, and most obviously, they spring from the study of air-to-air attrition battles that occurred in the skies over Korea. Second, recall that naval combat is a "force-on-force process, involving in the threat or realization, the simultaneous attrition of both sides" [Ref. 68:p. 5]. It is one of the ultimate expressions of attrition warfare. Yet consider the following description of naval combat:

> As the two opposing commanders make their allocations and deploy for battle, they are simultaneously making position and **timing** decisions. A naval battle starts well before the first weapons are fired. Both are taking a series of steps building toward a climatic decision, in which the winner will be the force which attacks effectively **first** (emphasis added). [Ref. 68:p. 7]

It is clear from this passage that high process speeds are just as important to the outcome of an attrition battle as they are in maneuver. Third, although an attritionist's selection of critical vulnerabilities is more rigid than a maneuverist's, once inside the storm of battle, a selective attrition command and action process is often just as important for victory. If one's survival is a concern, any target is not "just as good as another." Unless the most threatening targets are engaged first, a force may be destroyed before the advantage of higher process speeds can come into play. The ideas buried in Boyd's model are thus every bit as relevant to attrition as they are to maneuver. Only in **how** these ideas are applied in combat -- how the commander intends to shape war's environment -- do these two types of warfare significantly differ. The basic outline for an all-purpose action model that can be used to build a NSWA is thus revealed.

D. FIELD-STRIPPING THE O-O-D-A LOOP

Before continuing, it will be helpful to examine the O-O-D-A loop in a more systematic way. Boyd, in very broad, bold strokes, outlined the steps for a universally relevant combat model. But while "Patterns of Conflict" reports the end result of research based on this model, it contains precious little detail about the O-O-D-A loop itself. There is a growing tendency in the military services to use

theoretical terminology rather casually. The tendency is based on the dubious assumption of universal acceptance of the definitions of such terms [Ref. 52:p. 46]. To prevent confusion, what follows is the author's own interpretation and expansion of Boyd's basic command and action model. These interpretations will carry over into the framework of the NSWA.

Note that unlike the S-E-D-A cycle, the components of the O-O-D-A loop are described with nouns instead of verbs. As previously discussed, this is because Boyd views each step within the loop as a distinct process; they do not (although they can) denote one-step actions [Ref. 74]. It is interesting to ponder Boyd's exact choice of nouns to describe the loop's four subprocesses. Since he never explicitly defines these terms in his study, one is forced to go to the dictionary to unlock the subtleties of his creation.

Observation is the loop's trigger. It is the act, practice, or power of noting and recording acts and events. It also describes the data so noted and recorded [Ref. 19:p. 1235]. There are three important points here. First, events or facts noted but not recorded do not add to the process. Second, the "power" of observation implies that observation is not simply an act, but a talent that will vary from leader to leader, force to force. Third, the output of the process is data, not information. The distinction is critical: data is merely a listing of the facts and events noted and

recorded; information is that which alters or reinforces a commander's understanding about his environment. Since commanders base decisions on information, not data [Ref. 75], observation implies, even requires, an intermediate subprocess before a commander's decision can be made.

In a Clausewitzian sense, observation is an attempt to pierce the fog of war and to increase a commander's level of certainty -- certainty about the level of immediate danger; certainty about the state and activities of enemy force; certainty about the countless factors that together constitute the combat environment; and certainty about the state and activities of friendly forces [Ref. 45:p. 264]. Observation is thus seen to have four key components. First, observations may be made to alert or warn the commander of imminent danger. Observations of this type, designed specifically to prevent surprise through early warning of enemy threats, will hereafter be referred to by the phrase "watch and listen." If watch and listen is the shield provided by observation, then "search and scout" is the sword. This is the determined attempt to seek out an enemy's critical vulnerabilities. In the process, searching and scouting also find enemy strengths. In other words, this type of observation is aimed at increasing the commander's level of certainty about the overall state of enemy forces. Combat factors determination is self-explanatory. It describes all observations made to characterize the general and specific battle environment,

i.e., weather, terrain analysis, etc. Finally, there is "force monitoring," critical self-observations made by both the commander and his forces on their state of readiness.

Personal observations by a commander may trigger the start of a O-O-D-A loop. Normally, however, the scope of battlestorms prevents the commander from being able to personally observe the entire battlefield. As a result, observation is most often carried out for the commander by his forces and the technical means at their disposal. Observations made by higher or supporting forces may also be used by a commander to help reduce his level of uncertainty, but for now the focus is only on those forces and assets that combat leader can directly control to help him peer through the fog of war.

Even with the help of his forces and their technology, a commander will sense only some of the activity within the combat environment. Friction and chance play an especially heavy role in the observation subprocess. Enemy preparations are missed, battlefield obstacles not spotted, events are misinterpreted, and friendly units do not report their readiness. Or perhaps the preparations and obstacles are spotted, but this data does not reach the commander. In any event, the transition from observation to the next stage of

the combat action cycle is marked by the transmission of some data to the commander.[5]

An important point here is that the amount of data received by the commander always seems inadequate in combat. In fact, the level of friction in the observation subprocess might be conceptually measured by the percentage of data that fails to reach the commander, plus the percentage of received data that is based on false perceptions by observers. As the level of friction climbs, so too does the probability that critical events or facts will never reach the combat leader. Friction in the observation subprocess, multiplied by the effects of chance, is one of the primary causes of surprise in combat.

The next stage of the Boyd cycle is **orientation.** Orientation is the familiarization with the adaptation to a situation or environment; the interpretation of the environment as to time, space, objects, and persons. The key word here is interpretation, which means to have one's own understanding of the meaning of [Ref. 19:pp. 960 & 1261]. In other words, orientation is the process of collecting all data from observation, converting it into information, and then interpreting the information in such a way as to form a mental picture of the environment. Since the commander's own

[5]The transition between stages within the O-O-D-A loop, or between separate loop iterations, is called a "transient maneuver" by Boyd. Fast transient maneuvers are an important contributor to high process speeds, i.e., high tempo [Ref. 73:p. 6].

interpretation of information is always based on incomplete or false data, it may or may not be correct. It is merely an impression -- a vague notion or feeling; an inkling of the way things are [Ref. 19:p. 916].

Although the commander often has a staff to help him collect and collate data streaming in from the observation stage, and even to help him convert that data into information, orientation in essence describes his personal interpretation of available information. It is therefore the part of Boyd's loop that helps explain the role of uncertainty in war:

> Since all information and assumptions are open to doubt, and with chance at work everywhere, the commander continually finds that things are not as he expected. This is bound to influence his plans, or at least the assumptions underlying them. If this influence is sufficiently powerful to cause a change in his plans, he must usually work out new ones; but for these the necessary information may not be immediately available...Usually, of course, new information and reevaluation are not enough to make us give up our intentions; they only call them in question. We now know more, but this makes us more, not less uncertain. [Ref. 42:p. 102]

Orientation is thus a critical intermediate stage in the combat action process. This stage reflects the inner psychological struggle that takes place in the mind of the commander. The commander is faced on one hand with contradictory and uncertain information and on the other with a need to do something about his enemy. At the very least, he must objectively evaluate the information, being careful not to interpret what is available as he would like or hope it to

be [Ref. 49:p. 27]. The most he can hope for is that he is blessed with that Clausewitz referred to as <u>coup d'oeil</u> -- the inward eye -- the "quick recognition of the truth that the mind would ordinarily miss or would perceive only after long study and reflection [Ref. 42:p. 102]. In either case, until the commander forms an impression about the environment, the cycle is stalled, and he cannot mold or shape the combat climate. Throughout this period of indecision, the commander and his forces are at the mercy of chance, disorder, and the enemy. As such, this stage is the focal point of both surprise and deception in war.

At some point the commander is either satisfied with or is forced by time or events to accept the information at hand. The commander's unique synthesis of the available information determines his impression of the environment with respect to time, space, and enemy and friendly forces. A commander's "final" interpretation of the environment -- his estimate of the situation -- marks both the end of orientation and the transient maneuver to the next stage of the combat action process.

Decision describes the act of deciding or settling a dispute or question by giving a judgment; the act of making up one's mind [Ref. 19:p. 471]. It is the central hub of the O-O-D-A cycle: observation and orientation are two preparatory steps toward decision, while action represents its physical manifestation. A commander's decision is based squarely on

his personal estimate of the situation, which indicates what has to be done with respect to the enemy. This estimate springs from impressions of danger, uncertainty, or enemy and friendly vulnerabilities. In the first case the commander seeks to prepare/deploy his forces to meet the perceived threat; in the second to seek new information; in the third to concentrate and threaten or attack; in the last to disperse or defend. In all cases, the commander may seek to deceive his enemy about his intentions. Regardless of the decision, however, its intent is the same: to shape the climate of combat or direct the fury of battle to gain a combat advantage.

The decision subprocess implicitly includes all tasks that help the commander to make up his mind and to convert his decision into a coherent plan of action. Thus command and staff actions are an integral part of the decision stage. These include, but are not limited to, selecting objectives, preparing alternative courses of action, developing detailed plans. Never forget, however, that like orientation, the decision stage is focused on and is the sole responsibility of the commander. It is the commander alone who must select a course of action with an acceptable degree of risk; and it is his creative ability which devises a plan that takes friction into account and has a reasonable chance of success [Ref. 51:pp. 19-20]. An additional requirement is that his selected course of action and its associated plan conform to

direction and guidance from other senior commanders (i.e., ROE's), so as to ensure coordinated action within the combat force.

While a cogent and accurate decision, backed up by the most detailed plan possible within time constraints, is the goal of the decision process, it does not mark its end. Unless the commander's intent and plan are relayed to his forces, the combat action cycle once again stalls. Moreover, unless the commander reports his decisions and supporting requests to higher levels of command, he runs the risk of disrupting both his own and his senior's plans. Transmitting orders, plans, and requests are the final outcome of the decision subprocess, and mark the transient maneuver to the last and final stage of the O-O-D-A loop. This transition is one of the key targets of the enemy; if it can be severed or delayed, he gains a significant advantage in battle. Since transmission of orders now occurs almost exclusively by electronic means, the move to disrupt this link has its own title: radio-electronic combat, or REC.

The commander's orders set his forces into **action** -- the state of acting or moving; the exertion of power or force [Ref. 19:p. 20]. Action is the agent of change in the combat environment, and is measured by potential or actual combat power generated by the commander's forces. The focus of action, like the commander's decision which prompts it, is thus always on the enemy.

Actions can be characterized in two complementary ways. The first is by description: i.e., rehearsal, reposition, demonstration, attack, or deception. This approach is measured by potential combat power; it reflects the commander's intent -- how he desires to mold or shape the climate of combat in his favor. The second way is by decomposing the description into specific combat acts: i.e., shoot, move, or communicate. This approach is concerned more with how these acts contribute to the generation of actual combat power.

However they are categorized, actions cause one of three changes to the combat environment. A change may first be expected, and compel the enemy to do generally what the commander wants them to do. Second, a change may be totally unexpected, leaving the enemy in either the same or even superior position. As the commander's forces constantly battle friction as well as the enemy, this type of outcome is common in combat. Finally, the changes may be expected, but cause negligible effect on either the enemy or the environment. In this case, the actions either lack relevance -- they are not directed against a critical vulnerability -- or they have been "overtaken by events." In other words, the impression upon which the commander's estimate of the situation and the decision was based is wrong or is outdated and superfluous. This is often the outcome when the enemy is operating with higher relative process speeds. Whatever the

intended effect, however, change to the environment marks the trigger for, and the transition to, a new O-O-D-A cycle.

E. SUMMARY

The elegant simplicity and deceptive complexity of John Boyd's O-O-D-A loop make it an ideal action model for use within the framework of a NSWA. Figure 8 is a final look at the O-O-D-A loop based on the key points covered above, with one additional twist: the figure shows the interaction between two O-O-D-A cycles. The cycles depict leaders operating at two different levels of war, or a combat leader and his immediate superior within the same level. Of course, imbedded within the action stage of both commanders are similar cycles for all of their subordinate leaders, but for simplicity's sake, these are not shown. Two quick observations follow.

Advances in data transmission technology blur the distinction between the two observation subprocesses. Armed with the necessary devices, commanders can now receive data directly from observers over whom they have no direct control. Because of the high level of uncertainty in war, this sharing of observation platforms and their data is natural; the larger the number of observers, the greater the chance that truly significant events will be recorded. The incestuous relationship is much different than the exchange of information that routinely occurs between the two orientation

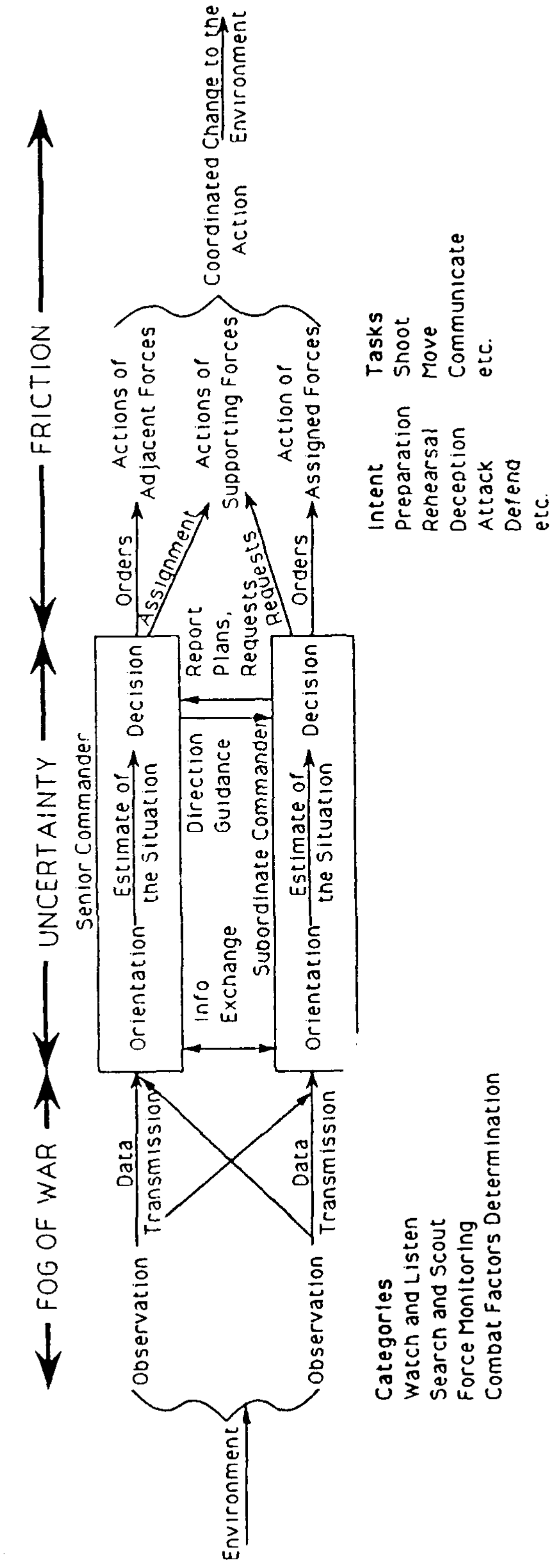

Figure 8. The O-O-D-A Loop: A Review

subprocesses. There the exchange deals with processed, instead of raw data. As a result, the receiver of the information is less certain about its accuracy or the means by which it was derived.

As mentioned before, one goal in war is to achieve coordinated combat action. This demands a close relationship between commanders in and within different levels of command. As indicated in Figure 8, this relationship is maintained by sharing information, by direction and guidance down the chain of command, and by requests and reports up the chain of command. But notice that these exchanges between different commanders occur only at the beginning of the second stage and the end of the third. This is because it is difficult to break up the orientation-decision chain, as it is so dependent on the individual commander and is own impression of the environment. The critical importance of the commander's wartime role should now be obvious.

Having looked at the nature of war, developed important warfighting concepts, and built an effective combat action model, the groundwork is now complete. In the next chapter, the National Space Warfighting Space Architecture will be erected.

VII. A NATIONAL SPACE WARFIGHTING ARCHITECTURE

A. INTRODUCTION

In the previous four chapters, the author has attempted to forge a common conceptualization of: the NSWA's appropriate baseline combat missions; its unique operating environment; individual and organizational combat decision-action processes; and important concepts that will help to logically organize the architecture. In the process, the author has also sought to develop a common vocabulary among managers of the SSRSP, space support officers, and warfighters of all services. The stage is now set to combine and unify all of the preceding terms, ideas, and concepts into a cohesive framework for dialogue about space-based combat support. This framework takes the form of a National Space Warfighting Architecture.

To reemphasize, the architectural design that follows is not intend to be complete; it is a top level architecture only. As the reader will recall, the central premise of this thesis is that a space warfighting architecture is the most effective alternative to fill the void that exists between the National Space Policies and emerging service space warfighting plans. The purpose of this chapter is to present one possible template for a NSWA, and to defend the logic behind its construction. In so doing, the author hopes to make clear

the architecture's usefulness as framework for debate about space-based combat support.

B. A PROPOSED NATIONAL SPACE WARFIGHTING ARCHITECTURE

1. General

Figure 9 is a top-down decomposition of a proposed NSWA. From top to bottom, the architecture consists of the following five sublevels: (space combat) mission; (supported) level of command; (command and action) process; (process) function; and (feasible technology) task(s).

Although many of the terms and phrases used within the architecture will be recognized from the groundwork laid in the previous chapters, the reader is cautioned not to become overly focused on the particular phraseology developed by the author. Instead, the reader should concentrate on the reasoning behind, and the advantages of, the particular architectural framework depicted. If and when a top level NSWA is pursued, the national security space sector would have to agree upon and fully define all of its component parts. The terms contained herein are simply recommendations based upon the author's research and perspectives.

Note that the architecture's decomposition strategy is shown for only one of the NSWA's three combat missions. This thesis is most concerned with space-based support of terrestrial operations, and what follows will reflect this

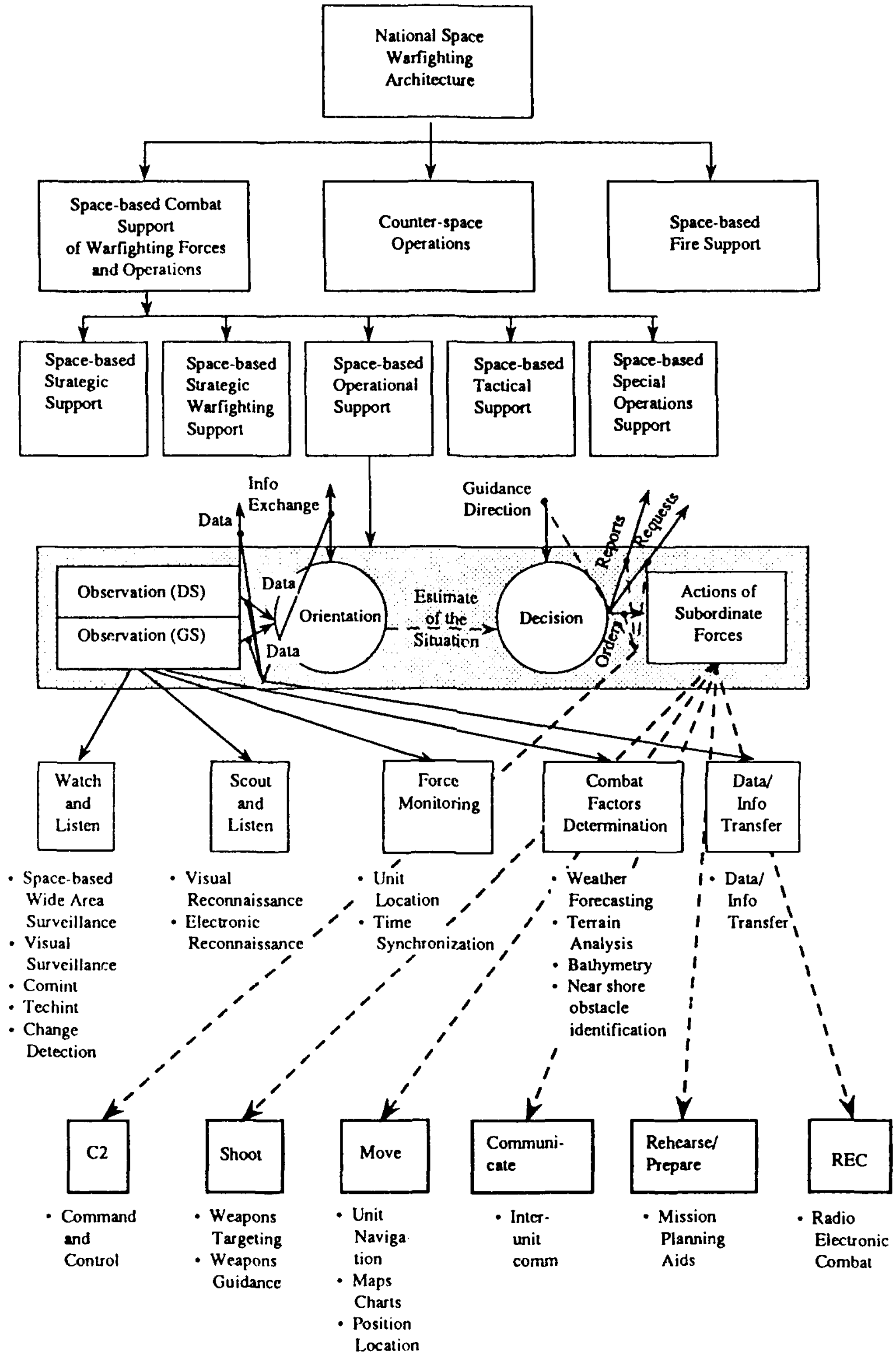

Figure 9. National Space Warfighting Architecture

emphasis. Suffice it to say, the decomposition strategy for the other two missions would be identical down through the function sublevel. In other words, the only difference in the decomposition strategy for "Counter-space Operations" and "Space-based Fire Support" would be found at the feasible technology task sublevel. As the primary aim of this thesis is to demonstrate one possible template for the NSWA and to defend the logic behind its construction, concentrating on only one mission will in no way prevent the objectives of this thesis from being met.

2. The (Space Combat) Mission Sublevel

An architecture springs from, and its structure is guided by, a set of explicit design missions. It should therefore come as no surprise that the first sublevel identifies the NSWA's appropriate combat missions. However, the reader will notice that the mission titles do not exactly match the baseline combat missions identified in Chapter III. Why the switch in titles? What exactly do these combat missions entail? How do they differ from the missions designated by national policy? The purpose of this section is to answer these questions.

First, the switch in titles. Changing the skeptical attitude that many warfighters feel about space-based combat support will require a coordinated, multi-level effort. This effort would include, among other things, better education (based on relaxed security requirements), training, and space

support exercises. However, the glue to hold all of these highly visible programs together is a common vocabulary and conceptual view of space support among the warfighter, space support officers, and managers of the SSRSP. And in this author's opinion, the emphasis of the extant space support vocabulary is too remote from its warfighting roots. How many infantry battalion commanders talk about "force application?" How important is "space control" to the operations of a fighter squadron? Just what does "force enhancement" mean? Does force refer to an aggregation of combat units, or to combat force, the prerequisite for generating combat power? To be successful in its intent, the National Space Warfighting Architecture must use terms that the warfighters both understand and appreciate. The titles of the NSWA's combat missions are chosen with this thought in mind.

Space-based Combat Support of Warfighting Forces and Operations involves using on-orbit space systems to create an advantage in terrestrial combat. It is analogous to the force enhancement space mission. Its final aim is to improve both the combat effectiveness and combat performance of terrestrial fighting forces. The former is accomplished by using space systems to help reduce the commander's level of uncertainty and help him to identify enemy critical vulnerabilities; the latter by using space systems to help reduce the frictions encountered by the commander's forces in combat. Space-based combat support is realized through the delivery of data from

on-orbit spacecraft to either the commander or the warfighter. Indirect space-based combat support involves the exchange or receipt of preprocessed information that includes at least some input from space systems. When reviewing this preprocessed information, the parts derived from space platforms may or may not be obvious to the warfighter. [Ref. 12:p. 1-2].

Counter-space Operations are related to, but conceptually broader than, the space control mission. Its title is specifically chosen to soften the politically threatening tone of "space control;" and to emphasize that its primary intent is to support terrestrial operations and not to "dominate" the heavens. It involves all activities taken by warfighting commanders and their forces to degrade the performance of enemy space support capabilities. In other words, counter-space operations aim to increase force effectiveness by providing a relative superiority in space combat support. This mission includes, but is not limited to: space reconnaissance to identify the function of enemy space systems; space surveillance to provide early warning of attacks on friendly space assets; defensive space maneuvers; terrestrial evasion and other deception operations; attacks on enemy space command and control, launch, and dissemination networks; and ground-based antisatellite operations. It would also include those actions taken to ensure that the enemy did not benefit from US space capabilities. The intentional

corruption of the GPS commercial signal is an example of such actions.

Space-based Fire Support is related to the force application mission. Its aim is self explanatory -- the delivery of fires in direct or general support of either terrestrial forces or friendly space assets. The key is that the fire support is delivered from an orbiting weapon system. Although national policy now focuses mainly on space-based defensive fires in support of the strategic and strategic warfighting levels of war, this mission conceptually embraces offensive and defensive fire support satellites in support of any level of war. Again, however, this is a pure combat mission; it guides but does not include associated research and development activities such as the Strategic Defense Initiative.

3. The (Supported) Level of Command Sublevel

The Level of Command sublevel, patterned after the levels of war/command introduced in Chapter V, is the linchpin of the NSWA's "how-to-organize" approach. This sublevel serves two primary purposes. First, it makes clear that during times of war, the entire national security space program exists for one reason: to help the warfighter -- be it the strategic CINC or a division commander -- to gain a relative advantage in war and combat. Second, it implies that the relative advantage sought from space-based support may be different depending on the support level of command. As was

discussed in Chapter V, warfighting commanders at different levels of war view and attack their enemy's critical vulnerabilities in subtly different ways. This level paves the way to emphasize and identify these differences.

In addition to these two primary goals, this sublevel serves several additional supporting aims. It puts the focus of the architecture on the commander and his forces, and not on the space technology that serves him. It organizes the architecture's decision makers in a logical, hierarchical way, thus facilitating the use of command overlays with the NSWA. This will help warfighters to better understand where and how their own combat organizations fit within the architecture's framework, as well as the relationship among senior and subordinate level commanders, all of whom compete for space support. This sublevel will help to standardize and clarify space support terminology. For example, a "tactical satellite" will have a specific, easy to understand meaning: a satellite designed to provide direct support to division-level and smaller units preparing for or engaged in battle. It will aid all services to better focus their own space warfighting doctrine; i.e., Marine Corps space warfighting doctrine is concerned essentially with space-based operational, tactical, and special operations support. Finally, when decomposition is continued down through the subarchitecture level, this organizational scheme will allow the services to more accurately match system measures of

performance with the specific levels(s) of war that the system is designed to support.

4. The (Command and Action) Process Sublevel

Having put the focus of the NSWA squarely on the terrestrial fighting forces, the next sublevel describes their combat command and action process. Recall that all forces, at every level of war, go through conceptually identical combat decision-action cycles. To be sure, the aim, scope, and duration of the cycles at each level of war are different, but their basic steps remain the same. These steps, defined by the Observation-Orientation-Decision-Action loop introduced and discussed in Chapter VI, form the process sublevel's four components.

Building the NSWA around a universally relevant command and action model serves three key purposes. The model makes the NSWA equally suitable for use by an infantry battalion commander, a carrier battle group commander, or a unified commander. It provides a powerful conceptual framework for discussion -- specific enough to shape debate about space-based support among leaders with diverse views and perspectives, yet flexible enough to accommodate their different background and wartime missions.

Second, because the model emphasizes the inextricable wartime relationship between the commander, his decisions, and the resultant actions of his forces, it helps to highlight the two conceptual roles that space-based combat support fulfills

-- reducing the commander's level of uncertainty and limiting the effects of friction on his forces. In this, the model seems clearly superior to a command and control alternative, which emphasizes the former role at the expense of the latter.

Finally, by including the command and action process as an integral part of the architecture, each service has the flexibility to pursue its own space warfighting doctrine without undue constraints. Since the climate of combat is ever-changing and unpredictable, a warfighting organization must continuously adapt if it is to survive and impose its will on its enemy. A successful fighting force therefore foregoes preset rules and instead embraces and pursues an environmental adaptation strategy -- a doctrine -- that both anticipates and facilitates rapid adaptation to changing events. Such a doctrine is designed to inculcate the need for combat forces to influence the wartime environment rather than be swept along by it, thereby providing the basis for successful combat operations.

Note that there is no separate "doctrinal" sublevel which explicitly lists the influencing approach that a command level elects to follow. This is in keeping with the author's belief that a national space warfighting doctrine is neither practical nor desirable. As has been discussed, the Air Force and the Navy are compelled by the special characteristics of their "battlefields" to pursue a technology-driven attrition doctrine. Meanwhile, both the Army and the Marine Corps are

turning increasingly toward the idea-driven maneuver approach [see Refs. 37,54,&62]. Moreover, although a service may embrace a specific adaptation approach as its general warfighting doctrine, warfighting commanders and their forces often combine both attrition and maneuver in their operations. Building the NSWA around a universal combat action model that describes both attrition and maneuver with equal effectiveness does three things. It obviates the need for an overly restrictive national space warfighting doctrine. It provides each of the services the flexibility to develop their own unique space warfighting doctrine while at the same time fostering cohesiveness and common understanding regarding space-based combat support. And it provides the conceptual foundation for commanders and their forces to explore new tactics and operations based on space-based support.

One final point. Note that the observation subprocess is divided into direct support (DS) and general support (GS). Direct support observations are made by space systems under the direct control of the supported commander. That is to say, the space system is a dedicated observation platform that responds to the supported commander's **tasking**. This does **not** (although it can) mean that the supported commander is responsible for the on-orbit control of the observation platform. On the other hand, general support observations are those made in response to taskings by another level of command, but whose resulting data is available for **direct**

receipt by a combat commander. Therefore, general support observations are distinct from the sharing of preprocessed space information between the orientation subprocesses of different levels of command.

The advantage of explicitly showing this breakdown is to set the stage for being able to flexibly designate a shifting main effort in space-based observation support. Imagine, for example, that an especially important campaign is about to begin. The initial main effort of the campaign is a Marine Expeditionary Force (MEF) landing. To fully integrate space-based support into his operations, the MEF commander would be assigned space observation assets in direct support -- he would have the authority to task on-orbit systems to reduce his level of uncertainty. After the MEF has established itself ashore, another unit might be designated the campaign's main effort. From this time on, the MEF commander would receive only general support from on-orbit systems, and would have to rely on other organic assets or forces in his observation effort.

5. The (Process) Function Sublevel

Regardless of the words or phrases used to describe them, the next sublevel's components are the generic functions that fully define each of the activities within the process sublevel. The reader will recognize the phrases as those introduced by the author in Chapter VI. However, as was stated in the introduction to this section, the specific

definitions are less important than the theme or concepts that they represent.

Notice that the functions listed are associated only with the observation and action activities, as well as the transient maneuvers that link them to the two middle stages of the O-O-D-A loop. Both orientation and decision are primarily mental subprocesses that defy any easy description or decomposition. Together these two stages define the art of command. On the other hand, both the observation subprocess, which is an integral step leading up to the commander's decision, and the action subprocesses, which transforms that decision into some tangible result, involve systematic and repetitive actions carried out in large part by a commander's forces. The constant and repetitive nature of these actions make the observation and action subprocesses relatively easy to describe and decompose.

One purpose of the function sublevel is strictly organizational. It aims to establish a clearer conceptual link between the appropriate activities of the command and action process level and those functional tasks that can be accomplished from space. For example, feasible technological tasks associated with seeking out enemy critical vulnerabilities are grouped under "scout and listen" instead of just "observation." This extra decomposition stage helps to better separate and identify system performance requirements based on their conceptual intent.

A second purpose of the function sublevel is to again highlight the two primary ways in which space-based combat support can be used to create a wartime advantage. Quite clearly, the functions grouped under the observation subproccess describe the four types of information that a commander needs most to make a decision: the immediate prospect of armed violence on the enemy's terms; the state and dispositions of both friendly and enemy forces; and the characteristics of the battlefield. Meanwhile, the functions listed under the action subprocess are those often degraded or modified by the frictions of war. When viewed as a whole, the function sublevel therefore provides a clear conceptual difference between using space to reduce the commander's level of uncertainty and using space to attempt to moderate the effects of friction in his forces.

6. The (Feasible Technology) Task Sublevel

The tasks listed in the architecture's bottom sublevel are meant to be neither exhaustive nor suggestive. They merely represent some of the command and action processes' component tasks that might conceivably be accomplished from space. In keeping with the spirit of this thesis, the author has no intention of defining or explaining each and every technological task listed. Instead, the role of the sublevel will be discussed in general, using examples as appropriate.

In a complete NSWA, tasks listed at this sublevel with an associated subarchitecture would indicate to the warfighter

that the space-based capability to accomplish the task is either operational or in late stages of development. The subarchitecture would provide detailed information about tasking and dissemination information flows, sensor systems, etc. Using this more detailed level of knowledge, the capability offered by space support systems could be fully integrated into combat plans and operations.

Tasks without an associated subarchitecture would indicate either one of two things. First, it could be a space-based capability identified as feasible by the Space Research, Development, and Acquisition Architecture but not yet being pursued by the warfighters. Perhaps the capability is duplicated by other, more cost effective alternatives; or perhaps the capability is not available due to political constraints (i.e., an anti satellite capability).

Second, it could indicate a technology concept that warfighters have identified to the SRDAA for further study or development. An example of this type of task is Space-based Wide Area Surveillance. The Navy and the Air Force agree such a task is necessary and feasible, but they have not yet agreed upon the specific technology to accomplish it. The Air Force favors an active radar system while the Navy prefers an infrared system (Ref. 76:p. 3]. Once the technology is selected and development is proceeding apace, one would expect that a subarchitecture would be introduced to help warfighters to plan and prepare how to best utilize the capability when

it becomes available. The give and take that would occur at this level between the NSWA and the SRDAA would better help to drive on-orbit capabilities specifically tailored to support terresetrial operations, and would hopefully prevent another "GPS scenario" from occurring.

In some cases, different tasks may be accomplished by a single space system that lends itself to several different functional applications. For example, the multi-spectral capability of LandSat lends itself to camouflage detection, terrain analysis, and near-shore obstacle identification. Moreover, while its 30-meter resolution makes it unsuitable for precise identification of targets, it is still useful as a surveillance tool to tip-off reconnaissance efforts when change is detected in a given area [Ref. 30:p. 14]. By listing all the tasks that a given payload can accomplish and associating it with the appropriate command action process function, warfighting commanders can better see the broad range of capabilities and cost effectiveness of space systems. Moreover, when such an approach is diligently followed, it will help consolidate spacecraft design and deployment efforts, avoiding costly duplication of effort.

Identifying specific functional tasks that can be accomplished from space also helps decision makers to make valid one-to-one comparison among space systems and similar terrestrial combat support systems. For example, space-based electronic reconnaissance satellites designed to identify

enemy orders of battle for specific levels of command can be readily compared to analogous terrestrial systems. Such a framework both sets the stage for meaningful tradeoff analyses among competing technological approaches, as well as highlights deficiencies in capabilities that might best be addressed through space systems.

C. THE NSWA AS A FRAMEWORK FOR DEBATE ABOUT SPACE-BASED COMBAT SUPPORT

1. General

As can be seen, a NSWA provides a powerful means for demonstrating to warfighters the real and potential utility of space in support of terrestrial wartime operations. That is, an NSWA, with associated subarchitectures, can be used as a framework for demonstrating the uses and roles of on-orbit systems, and how they might best be integrated into the combat action process. And it also provides a conceptual framework for developing new tactics based on unique space capabilities. However, an NSWA also provides the means to accomplish a third important function: debating the proper emphasis and direction of space-based combat support. To demonstrate, the author will quickly review four subjects raised in this thesis from the perspective of the NSWA proposed in the previous section.

2. Reducing Uncertainty versus Reducing Fiction

The NSWA is designed to bring into focus an important choice in the direction and conceptual intent of space-based combat support. When officers from the Naval Space Command

give briefs about their unit's mission, they show a slide that states: "Space = Information" [Ref. 77]. As far as it goes, this statement is certainly correct. But as the NSWA demonstrates, there are two different ways to use this information to gain a wartime advantage. One is to use it to reduce the commander's level of uncertainty and to help him pinpoint his enemy's critical vulnerability. The other is to use it to moderate the level of friction encountered by the commander's forces in combat. The former seeks to increase combat effectiveness while the latter aims to increase combat performance. The distinction between these two conceptual approaches may be subtle, but an emphasis of one over the other in the NSWA will have far-reaching implications on the direction of space-based combat support.

The present emphasis of national space-based combat support is clearly on reducing the commander's level of uncertainty. This emphasis is not surprising. As has been seen, the original motivation behind pursing a national security space capability was to reduce the strategic CINC's uncertainty about the Soviet Union's intentions and military capabilities. And in this endeavor the SSRSP has been singularly successful. As President Johnson stated (off the record) in 1967:

> ...we've spent 35 or 40 billion dollars on the space program. And if nothing else had come out of it except the knowledge we've gained from space photography, it would be worth ten times what the whole program has cost. Because tonight we know how many missiles the enemy has and, as it turned out, our

guesses were way off. We were doing things we didn't need to do...We were harboring fears we didn't need to harbor [Ref. 7:p. vii].

The very success of the SSRSP has, to a large degree, colored the subsequent conceptual development of national space-based warfighting support. For example, theater CINC's now believe that "given space systems' mounting value as force multipliers...(they) must be sure they will be given strong wartime backing" from space systems [Ref. 78:p. 36]. To be sure that they receive this backing, they seek the development of reconnaissance TacSats, which will be used to determine if "the enemy wing has dispersed, or if the bridge is still intact;" i.e., to reduce their level of uncertainty.

The emphasis upon using space information to reduce a commander's level of uncertainty leads naturally to heavy restrictions on its availability for other uses. Consider the following passage:

> The improvements in sensing, EW, and C^3 bring the "information war" to the forefront. The attempt to gain an information advantage by observing the other sides forces and activities while denying them such information about one's own forces becomes a primary rather than ancillary part of direct conflict. [Ref. 79: p. 77]

In an information war, the primary goal is to gain a relative advantage over the opposing commander by reducing friendly uncertainty while increasing the enemy's. With such a goal, protection of lucrative information sources becomes a paramount concern. The result is often compartmentation of

both the information itself, **as well as the means by which it is collected.**

This seems to be the primary motivation behind keeping basic capabilities of SSRSP satellites and operations so highly classified. The "take" from these satellites and operation is tightly controlled by the CIA and military intelligence services, and is reserved for use primarily by the highest levels of command. Information that is made available to operation and tactical commanders is carefully edited to protect its source, and is controlled within intelligence channels with strict dissemination and distribution guidelines [Ref. 78:p. 36]. As a result, the information is often not available for the second conceptual role of space-based combat support -- reducing combat friction.

At the lower levels of war, where disorder and chaos are at their maximum, critical vulnerabilities are not always evident and uncertainty is a fact of life. Commanders are often forced to pursue lesser vulnerabilities until a path to the critical weakness is discovered. It would therefore seem that at the lower levels of war, especially the tactical and special operations levels, space information is best suited for reducing the inevitable frictions that arise in pursuit of the enemy's critical vulnerability. As was discussed in Chapter IV, the effects of friction can never be eliminated. However, efforts can be made to moderate its potential impact.

One way to do this is through mission planning and realistic rehearsals. And new advances in space technology make possible revolutionary new ways to prepare, rehearse, and execute tactical missions.

For example, when satellite digital imagery is combined with LandSat and SPOT pictures, the resulting composite "gives...a detailed portrait of any battlefield or beach anywhere on the globe" [Ref. 78:p. 38]. This type of seemingly mundane information offers considerable combat advantages. As Napoleon said, one should always avoid a field of battle reconnoitered and studied by the enemy [Ref. 80:p. 8]. The vantage point of space offers the opportunity to deny potential adversaries the option of avoiding battlefields that are not familiar to US forces.

Mission rehearsal simulators offer similar exciting tactical possibilities. The Air Force is developing a mission planning system, where in 30 minutes or less a pilot can "pre-fly" an assigned combat mission through three-dimensional scenes that exactly replicate the terrain and landmarks he will see. The scenes are developed using electronically enhanced SPOT imagery [Ref. 81:p. 21].

Although the aforementioned system is dedicated to aviation, the potential tactical applications of similar systems are mind-boggling. Imagine a fast-moving mechanized force, maneuvering at night. Command vehicles, equipped with moving 3-D route displays based on satellite imagery, compare

the terrain depicted on the display with actual images of the terrain made by low-light level television cameras. When combined with GPS, which confirms the positions of column vehicles and synchronizes the entire force in time, the mechanized unit will be able to move quickly at night, hit checkpoints with precise timing, anticipate ambush sites, and exploit the terrain to best advantage in meeting engagements.

Clearly, the use of national space systems to help moderate the effects of friction in combat offers substantial tactical potential. However, to fully develop this potential, many of the present restrictions on space images and information about their data transfer and dissemination would have to be lifted. The NSWA provides a framework to explore the tradeoffs between the increased combat performance expected from making space information more widely available outside intelligence channels and possible compromises necessary in the information war raging at the higher levels of command

3. TENCAP versus TINCAP

At the beginning of this thesis, the author claimed that before space combat support could be fully integrated into terrestrial operations, the widespread "TENCAP attitude" would have to be changed. One conceptual alternative to the TENCAP approach toward space-based combat support was proposed: the Tactical Integration of National Capabilities. Upon reflection, the debate about whether space information

is best used to reduce the commander's level of uncertainty or the forces' level of friction helps to highlight the difference between the TENCAP and TINCAP approaches. The TENCAP approach emphasizes using space information to reduce uncertainty. Its heritage of protecting the source of space information has both shaped and stultified the conceptual development of national space-based combat support. The TINCAP alternative acknowledges that space can best be used to reduce the commander's level of uncertainty at the strategic, strategic warfighting, and operational levels of war. However, it expands the role of national systems to include moderating the effects of friction at the tactical and special operations levels of war. It truly seeks to bring the parts of space-based combat support together as a whole, to unify the conception of how space can best be used to win war on earth.

As a result, the author would like to modify the contention that a national space warfighting doctrine is neither practical nor appropriate. The basic doctrine of space-based combat support, the most fundamental and enduring beliefs that guide the proper use of space-based combat support in terrestrial military action, should be the Tactical Integration of National Capabilities. This doctrine applies equally well to all services, as well as the other important components of the national security space sectors. Moreover, it provides the solid foundation upon which the services can

develop their own operational space doctrine. If embraced and practiced, a TINCAP doctrine might very well hasten the day when commanders view space-based support to be as important in combat operations as airlift and artillery support.

4. TacSats

The NSWA also helps to clarify the debate about TacSats. First, "TasSats" is an inaccurate title. No one is recommending that direct support observation satellites be developed for division level and smaller combat units. Instead, TacSats are designed to be controlled by and provide direct support to theater and operational commanders. As such, the Air Force title for these satellites -- "Reserves" -- is more appropriate, and will be used hereafter [Ref. 82:p. 2].

The call for reserve combat support satellites is based on three interrelated factors. First, US military space planners worry mainly about war with the Soviet Union, the only potential military opponent with an operational ASAT capability [Ref. 83:p. 34]. As a result, they feel that:

> Current US systems are a fragile, thin blue line -- a thin blue line that is not sufficiently backed up by on-orbit spares or rapid replenishment capability. In times of crisis or conflict, these systems would not be sustainable. [Ref. 78:p. 38]

Second, as has been repeatedly emphasized, theater and operational commanders distrust assurances that in a crisis or major conflict SSRSP satellites will be available for combat support. And third, even if services from these

satellites are available, these commanders worry that the high classification and distribution restrictions on provided information will prevent its effective use in combat [Ref. 78:pp. 36-38].

Note that two of the reasons behind the calls for reserve satellites are based solely on attitudes or self-imposed restrictions, and the third is based on the most highly unlikely of all military scenarios -- war with the Soviet Union. An NSWA, supported by comprehensive DoD Space Campaign and national level Inter-campaign Coordination Plans, might provide the means to overcome these attitudes, and shift the focus of this debate away from developing expensive, duplicative space support capabilities and toward integrating national systems into combat operations.

Integrating national capabilities would require, among other things, the development of a better operational and tactical observation support structure. In 1986, for example, SSRSP imagery was available and used by officers planning the raid on Libya. However, dissemination and data restriction prevented the timely transmission of the photos to the units conducting the raid. As a result, the photos were hand carried from the US to the Mediterranean, a trip that took three days [Ref. 78:p. 36]. More recently, the Air Force Chief of Staff reported that when a senior commander in Operation Desert Shield was asked about whether he was getting enough space imagery, he replied, "I'm inundated with

pictures; what I need is someone to analyze them for me" [Ref. 84:p. 8]. Both examples are instructive, for they point to the real bottlenecks for effective integration. The former implies that the data dissemination network is deficient, and the latter that there are not enough imagery interpretation experts to handle a large increase in space-dervied imagery. Using the concept of flexibly designating main efforts in the space observation program; allowing the commander of the main effort to task national systems; improving the data/info dissemination networks to include the development of general support receivers; increasing the number of imagery interpretation analysts; and then **practicing** these procedures in peacetime space support exercises might demonstrate that the need for reserve satellites is not so clear in a post cold war world.

5. GPS Commercial Receivers

As was reported in the first chapter, both the Army and the Marine Corps were forced to make emergency purchases of commercial GPS receivers to outfit units deploying to Saudi Arabia. After the crisis in the Persian Gulf is resolved, further buys of commercial receivers should be carefully considered. The DoD originally planned to procure only military receivers -- those capable of converting the more accurate encrypted GPS signal. However, "budget pressures" are causing officials to consider supplementing purchases of

the military receiver with additional purchases of the cheaper commercial receivers [Ref. 85:p. 10].

While procuring additional receivers may make perfect "dollar" sense, it flies in the face of the conceptual intent of counter space operations -- increasing force effectiveness by providing a relative advantage in space-based combat support. Ten years from now, it is easy to envision that potential adversaries will have ready access to commercial GPS terminals. Recall that DoD has the flexibility to degrade the GPS commercial signal during times of war to prevent enemy forces from gaining operational benefit from the system. Should large numbers of US fighting units be equipped with commercial receivers and develop GPS-based combat tactics, it will be difficult, if not impossible, to exercise that flexibility.

VIII. CONCLUSIONS AND RECOMMENDATIONS

Compare the example of a "generic" Naval Space Warfighting Architecture (Naval SWA) introduced in Chapter I (Figure 1) to the proposed National Space Warfighting Architecture from Chapter VII (Figure 9). The major differences between these two architectures help to summarize the major points of this thesis. Specifically, a NSWA (along with the associated space campaign plans and supporting architectures) would: help fill the void that exists between National and DoD space policies and emerging service warfighting architectures; help unify space-based combat support efforts of the national security space program; help better educate warfighters about the formidable combat support potential of national space capabilities; open the way for the complete integration of national space-based combat support into terrestrial plans and operations; and provide a framework for debate about the proper emphasis. roles, and direction of space-based combat support.

First, the focus of the Naval SWA is clearly on its "space segment" -- the joint and service space commands, satellites, and the satellite and payload control networks. The warfighters are mere "users" of the services provided by

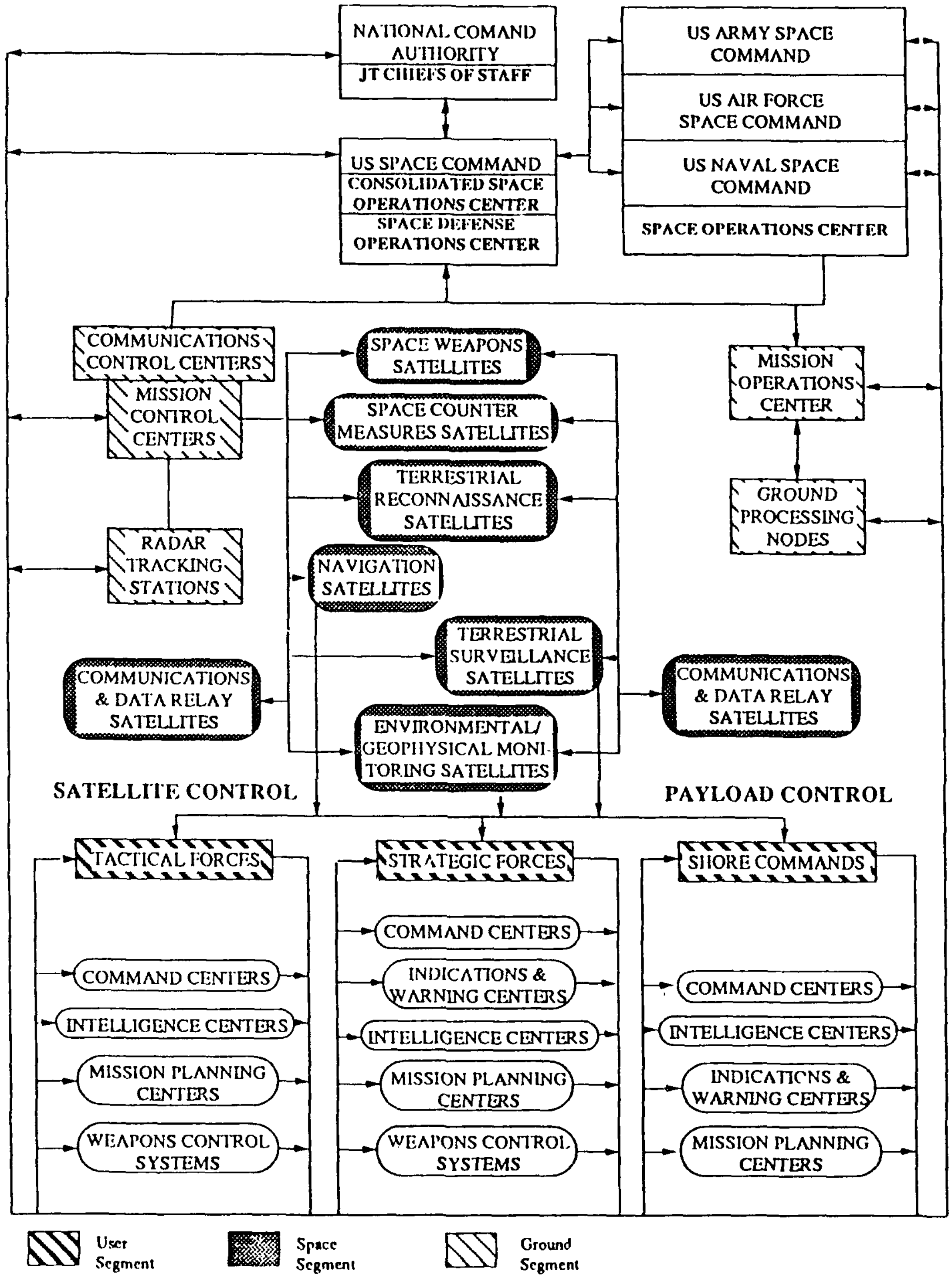

Figure 1. "Generic" Naval Space Warfighting Architecture

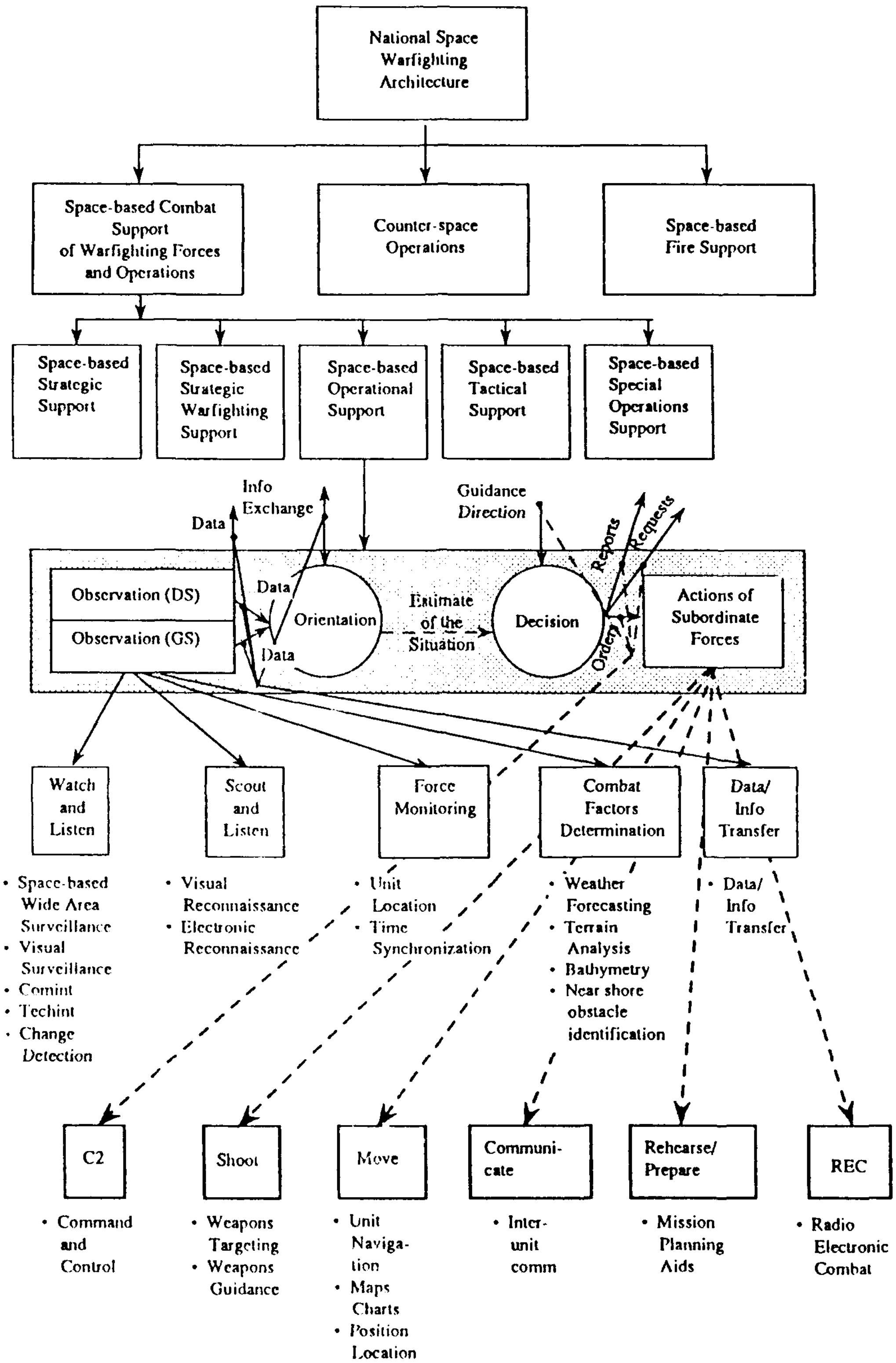

Figure 9. National Space Warfighting Architecture

the space segment. The focus of the National Space Warfighting Architecture is exactly the opposite. It is focused on the warfighting commanders and their respective forces. National security space capabilities do not exist for their own sake. They exist to provide fighting forces -- at all levels of war -- with a means to shape the climate of (terrestrial) combat in their favor. The NSWA is specifically constructed to confirm and reinforce this fundamental fact.

Second, the Naval SWA deals primarily with physical things: i.e., satellites, mission control and operation centers, and command centers. This is in stark contrast to the National Space Warfighting Architecture, which excludes physical structures entirely. The heart of the National Architecture is a conceptual command and action model. This model, patterned after Boyd's O-O-D-A loop, allows the NSWA to serve as a framework for discussion about the roles of space-based combat support among all services. It is equally relevant to every level of war and tactical situation.

The link between the NSWA's combat decision-action model and space technology is established by the architecture's technologically feasible task sublevel. This sublevel would attempt to list every relevant command and action task that can be, or could be, accomplished from space. In so doing, the NSWA (and its appropriate subarchitectures) serves two important purposes. It helps top portray how on-orbit space capabilities can be integrated into wartime plans and

operations so as to create an advantage in battle. And it helps to highlight the most promising candidates for future space-based combat support systems. The Naval SWA does include "technologically feasible satellites" (i.e., countermeasure satellites), but it fails to explain what combat tasks that these satellites would perform.

By focusing on the warfighting contributions that space systems offer from the perspective of the warfighter, the NSWA provides a framework for debate about national space-based combat support. Instead of a "user" of space systems, the NSWA aims to make the warfighter the "driver" of on-orbit combat capabilities. Space combat capabilities evolve around two roles: reducing the commander's level of uncertainty, and moderating the effects of friction on the actions of his forces. Unlike the Naval SWA, the national architecture helps to clarify these two roles. By so doing, the NSWA opens the way for meaningful dialogue between the services and the managers of the SSRSP about how the full potential of national capabilities could be achieved in operations and tactics.

In conclusion, the author would like to submit three short recommendations:

- <u>For the national security space sector</u>. Develop a National Space Warfighting Architecture along the lines proposed in this thesis. This would also entail the development of associated space campaign plans and supporting architectures. Consider the adoption of a national space warfighting doctrine of Tactical Integration of National Capabilities (TINCAP).

- For the US Naval Space Command. Change the emphasis of the Naval Space Warfighting Architecture from space systems to those the systems are designed to support: the warfighter. Use the framework proposed herein to help generate interest and debate about space-based combat support within the naval service.

- For the Marine Corps. Use the framework proposed herein to: develop Marine Corps unique space-based combat support doctrine; focus the Marine Corps education program about space-based operational and tactical combat support; and explore new tactics based on unique space-support capabilities.

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